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Vol. XVIII.
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THE FOSSIL CARNIVORA OF INDIA.

By
GUY E. PILGRIM, D.Sc., F.G.S., F.A.S.B.

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THE FOSSIL CARNIVORA OF INDIA.

BY

GUY E. PILGRIM, D.Sc., F.G.S., F.A.S.B.

INTRODUCTION.

DURING the years which immediately followed the discovery of the great bone deposits of the Siwalik Hills just a century ago, Falconer, Cautley, Baker and Durand published various short papers describing and often figuring some of their finds. These included species belonging to the Carnivora. Between the years 1845 and 1848 Falconer had many of these drawn for a work entitled 'Fauna Antiqua Sivalensis'. None of the plates of the Carnivora was actually published in this work, but after Falconer's death they were reproduced to accompany his Palæontological Memoirs edited by Murchison and published in 1868. In 1880 Bose wrote a paper on certain specimens of the Carnivora from the original collection in the British Museum, which had been overlooked or wrongly identified. Between 1876 and 1883 Lydekker wrote brief papers dealing with some of the Indian fossil Carnivora and finally in 1884 a comprehensive monograph on the Siwalik and Narbada Carnivora, not only revising the previous work but also describing for the first time several additional specimens which Theobald and other members of the Geological Survey of India had collected, chiefly from the area north of the Salt Range in the Attock and Jhelum districts, but also from the Hoshiarpur and Kangra districts, Jammu State and Sind. The Salt Range Carnivora are actually older than those of the Siwalik Hills but were not recognised as such at that period. From the year 1910 work on the ossiferous deposits of India was again resumed, and the study of the stratigraphy and the fossils enabled me to classify the strata according to their age forming a series of stages extending uninterruptedly from the Lower Miocene (Burdigalian) to the Lower Pleistocene, not including the Narbada and Godavari alluvium nor the cave deposits. A few of the new species of Carnivora discovered during this later period of work were described by myself in papers published prior to 1916 and by C. Forster Cooper in 1923. Some of the conclusions embodied in these were revised by Helbing (1925), Frick (1926), Kretzoi (1929) and Matthew (1929). The latter author has published critical observations on the whole of the Indian fossil fauna, including the Carnivora so far as known to him. Valuable as these are they hardly pretend to be more than impressions, while unfortunately Matthew had not access to all of the recent collections of Carnivora and some of his own conclusions stand in need of correction. The very names of the genera and species required alteration in accordance with modern custom in nomenclature, and Matthew's researches in regard to this form by no means the least important part of his 1929 paper.

His comments on Lydekker's work have, however, made it clear that a careful revision of the fossil Carnivora of India as a whole is called for. Such a work has in fact been in my mind for more than a decade and much of what now appears in print for the first time already existed in the form of manuscript notes for even longer than that. It has been delayed in the hope of augmenting the much too fragmentary material, so as to render my conclusions more convincing. Its publication is, however, long overdue and cannot be further postponed, inevitable as it is that the results now published must be far from final and must themselves be subject to revision in the light of future discoveries.

Collections studied.—The bulk of the material and most of the holotypes of the species which were found in the Siwalik Hills are preserved in the British Museum, to which Falconer and Cautley presented most of their collection. A small amount of additional material from the same area including a few types are in the Museum of the Royal College of Surgeons, London, the Science and Art Museum, Dublin, the Ipswich Museum and the Geological Museum in Calcutta. The last named collection is only in small part derived from Falconer's material; it comprises chiefly specimens collected in the Siwalik Hills during the last twenty years by the Geological Survey of India and from beds of corresponding age in the Salt Range area, as well as from the Hoshiarpur and Kangra districts, the ones from the two latter localities being due mainly to Theobald.

On the other hand the specimens collected from the earlier stages are almost without exception in Calcutta, although casts of holotypes and a few duplicates, in addition to all Cooper's Bugti Carnivora, may be seen in the British Museum, and to a smaller extent in the Museums of Basle, Munich, Paris and New York. The last named museum also possesses material, as yet undescribed, which was collected in India in 1921-1923 by Barnum Brown. The Calcutta material referred to includes valuable specimens collected by Theobald in the Salt Range, entirely from the Dhok Pathan stage. During the last twenty years the collections from this stage have been further increased by the Geological Survey of India, and in addition the Gaj, Kamlial, Chinji and Nagri stages have yielded a great amount of interesting material, which was entirely unknown previously.

Distribution of the species.—The table on pages 3-6 represents a close approximation to the facts, so far as concerns the distribution of species which occur in the Gaj, the Lower and the Middle Siwaliks, that is to say all except the later stages. Unfortunately the same cannot be said with regard to the Upper Siwalik species. This is due to the fact that the great majority of the species from the Siwalik Hills lack a precise record of the locality whence they came and, as but few of the Carnivora have been rediscovered, it remains in doubt whether they belong to the Pinjor or the Tatrot stage. Since the Tatrot stage of the Salt Range has yielded in abundance certain species belonging to other Mammalian orders, which Falconer described from the Siwalik Hills, but which have not been rediscovered from the Pinjor stage, it is open to suspicion that these and some others may have come from older beds than those from which the bulk of the Siwalik Hills fauna was obtained. *Mastodon sivalensis*, *Hippohyus*, *Sivachœrus* and *Hipparion* are the most important forms belonging to this category. Some indication of such a possibility is afforded by references in Falconer's writings (Pal. Mem. I, pp. 33-35) to 'the beds of the Kalawala Rau', though without naming any species which actually came from there. I have previously (Pilgrim 1910, p. 193; 1913, p. 339) mentioned these and have recorded the occurrence of *Hipparion* in them. Beyond a doubt they are below the Pinjor stage, and I then suggested that they might be Middle Siwalik. This suggestion I now consider to be improbable, but that they may represent the Tatrot stage of the Salt Range is far from unlikely. Beds of a corresponding level occur here and there at the southern edge of the Siwalik Hills between the rivers Ghaggar and Ganges, but no systematic search has been conducted in them so far as I am aware, while even if such a search had been made and had yielded little in the way of fossils, that would not necessarily prove the non-existence of fossils in them a century ago, seeing that careful collecting even in the Pinjor stage has brought to light hardly any of the species of Carnivora described by Baker, Durand and Falconer, in spite of the fact that we know for certain that some of these were actually collected from that stage.

Matthew (1929, p. 447) has suggested a possible difference in age on account of the varying type of fossilisation of the Siwalik Hills specimens in the British Museum. I do not lay great stress on most of the differences to which he alludes, knowing as I do that soft sandstone and hard flinty sandstone often occur in juxtaposition at Moginand and other localities in the Siwalik Hills, but the fact that the fossils found in the Kalawala Rau are pyritous, suggests a possible connection between certain black types of matrix amongst the British Museum specimens and the undoubtedly black, though fragile specimens which I found in the Kalawala Rau.

In conclusion, judging by the localities which have been recorded, and by the fossils which have been found during the last twenty years on undoubted Pinjor sites, I incline to the belief that the great bulk of the Upper Siwalik Carnivora belong to the Pinjor stage. That a few species may be of Tatrot age is possible, but since we have at present insufficient data to enable us to fix on these, it would be in the highest degree rash to classify any of them as Tatrot.

Fossil Indian species of Carnivora.

	Gaj.	**Kamlial.**	**Chinji.**	**Nagri.**	**Dhok Pathan.**	**Tatrot.**	**Pinjor.**	**Narbada.**	**Pleistocene caves and alluvium.**
CANIDÆ—									
Amphicyon shahbazi, Pilgrim .	+	..	..	..	..	..	..	..	..
Amphicyon cooperi, sp. nov. .	+	..	..	..	..	..	..	..	..
Amphicyon sindiensis, sp. nov. .	..	+	..	..	..	..	..	..	..

Fossil Indian species of Carnivora—contd.

	Gaj.	Kamlial.	Chinji.	Nagri.	Dhok Pathan.	Tatrot.	Pinjor.	Narbada.	Pleistocene caves and alluvium.
CANIDÆ—*contd.*									
Amphicyon palaeindicus, Lydekker.	..	..	+	..	..	..	..	..	..
Amphicyon pithecophilus, sp. nov.	..	..	+	..	..	..	..	..	..
Vishnucyon chinjiensis, sp. nov..	..	..	+	..	..	..	..	..	..
Arctamphicyon lydekkeri, Pilgrim.	..	..	..	..	+	..	..	..	..
Metarctos (?) *bugtiensis* (Cooper).	+	..	..	..	..	..	..	..	..
Canis cautleyi, Bose . . .	..	..	..	..	..	..	+	..	..
Sivacyon curvipalatus (Bose). .	..	..	..	..	..	..	+	..	..
URSIDÆ—									
Agriotherium sivalense (Falconer and Cautley).	..	..	..	..	..	..	+	..	..
Agriotherium palaeindicum (Lydekker.)	..	..	..	..	+	..	..	..	..
Indarctos salmontanus, Pilgrim	..	..	..	..	+	..	..	..	..
Indarctos punjabiensis (Lydekker).	..	..	..	..	+	..	..	..	..
Aelureidopus baconi, Woodward.	..	..	..	..	..	..	..	..	+
Melursus (?) *theobaldi*, Lydekker	..	..	..	..	..	..	+	..	..
Melursus ursinus (Shaw) . .	..	..	..	..	..	..	..	..	+
Helarctos namadicus (Falconer and Cautley).	..	..	..	..	..	..	..	+	..
PROCYONIDÆ—									
Sivanasua palaeindica, sp. nov. .	..	..	+	..	..	..	..	..	..
Sivanasua himalayensis, sp. nov.	..	..	..	+	..	..	..	..	..
MUSTELIDÆ—									
Sinictis lydekkeri, sp. nov.. .	..	..	..	..	..	..	+	..	..
Eomellivora (?) *necrophila*, sp. nov.	..	..	+	..	..	..	..	..	..
Eomellivora (?) *tenebrarum*, sp. nov.	..	..	..	..	+	..	..	..	..
Promellivora punjabiensis (Lydekker).	..	..	..	..	+	..	..	..	..
Mellivora sivalensis (Falconer and Cautley).	..	..	..	..	..	..	+	..	..
Vishnuonyx chinjiensis, sp. nov..	..	..	+	..	..	..	..	..	..
Sivaonyx bathygnathus (Lydekker).	..	..	..	..	+	..	..	..	..
Enhydriodon sivalensis, Falconer	..	..	..	..	..	..	+	..	..
Enhydriodon falconeri, Pilgrim .	..	..	..	..	?	?	..	..	..
Lutra palaeindica, Falc. & Caut .	..	..	..	..	..	..	+	..	..
Lutrine gen. indet. *hasnoti*, sp. nov.	..	..	..	..	+	..	..	..	..
Lutrine gen. indet. *furtivus*, sp. nov.	..	..	+	..	..	..	..	..	..
Sivalictis natans, sp. nov. . .	..	..	+	..	..	..	..	..	..
Incertae sedis, gen. et., sp. indet.	..	..	+	..	..	..	..	..	..
Incertae sedis, gen. et., sp. indet.	..	..	..	..	+	..	..	..	..

Fossil Indian species of Carnivora—contd.

	Gaj.	Kamlial.	Chinji.	Nagri.	Dhok Pathan.	Tatrot.	Pinjor.	Narbada.	Pleistocene caves and alluvium.
VIVERRIDÆ—									
Viverra chinjiensis, sp. nov.	..	..	+	..	..	..	..	..	..
Viverra bakerii, Bose	..	..	..	..	..	..	+	..	..
Viverra karnuliensis, Lydekker	..	..	..	..	..	..	..	..	+
Vishnuictis salmontanus, sp. nov.	..	..	..	..	+	..	..	..	..
Vishnuictis durandi (Lydekker)	..	..	..	..	..	..	+	..	..
Prionodon sp., Lydekker	..	..	..	..	..	..	..	..	+
Herpestes griseus, Desmarest	..	..	..	..	..	..	..	..	+
Herpestes fuscus, Waterhouse	..	..	..	..	..	..	..	..	+
HYAENIDÆ—									
Ictitherium sivalense, Lydekker	..	..	..	..	+	..	..	..	..
Ictitherium indicum, Pilgrim	..	..	..	..	+	..	..	..	..
Hyaenictis bosei, Matthew	..	..	..	..	..	..	+	..	..
Lycyaena macrostoma (Lydekker)	..	..	..	..	+	..	..	..	..
Lycyaena macrostoma var. *vinayaki*, var. nov.	..	..	..	..	+	..	..	..	..
Lycyaena proava, Pilgrim	..	..	+	..	..	..	..	..	..
Lycyaena chinjiensis, sp. nov.	..	..	+	..	..	..	..	..	..
Crocuta carnifex, Pilgrim	..	..	+	..	+	..	..	..	..
Crocuta gigantea (Schlosser) var. *latro*, var. nov.	..	..	..	+	+	..	..	..	..
Crocuta mordax, sp. nov.	..	..	..	..	+	..	..	..	..
Crocuta sivalensis (Falconer and Cautley).	..	..	..	..	..	..	+	..	..
Crocuta felina (Bose)	..	..	..	..	..	..	+	..	..
Crocuta colvini (Lydekker)	..	..	..	..	..	..	+	..	..
Crocuta sp.	..	..	..	..	..	..	..	..	+
FELIDÆ—									
Aeluropsis annectans, Lydekker	..	..	..	..	+	..	..	..	..
Vinayakia sarcophaga, sp. nov.	..	..	+	..	..	..	..	..	..
Vinayakia nocturna, sp. nov.	..	..	..	+	..	..	..	..	..
Mellivorodon palaeindicus, Lydekker.	..	..	..	..	+	..	..	..	..
Hyainailouros bugtiensis (Pilgrim).	+	..	..	..	..	..	..	..	..
Hyainailouros lahirii, sp. nov.	..	+	..	..	..	..	..	..	..
Sansanosmilus (?) *serratus*, sp. nov.	..	..	+	..	..	..	..	..	..
Sansanosmilus (?) *rhomboidalis*, sp. nov.	..	..	+	..	..	..	..	..	..
Sivasmilus copei, Kretzoi	..	..	+	..	..	..	..	..	..
Propontosmilus sivalensis (Lydekker).	..	..	..	..	+	..	..	..	..
Paramachaerodus pilgrimi, Kretzoi	..	..	..	..	+	..	..	..	..
Paramachaerodus indicus (Kretzoi).	..	..	..	..	+	..	..	..	..
Machairodus or *Epimachairodus*, sp. indet.	..	..	..	..	+	..	..	..	..
Megantereon (?) *praecox*, sp. nov.	..	..	..	+	..	..	..	..	..
Megantereon (?) *falconeri*, Pomel.	..	..	..	..	..	..	+	..	..

Fossil Indian species of Carnivora—concld.

	Gaj.	Kamlial.	Chinji.	Nagri.	Dhok Pathan.	Tatrot.	Pinjor.	Narbada.	Pleistocene caves and alluvium.
FELIDÆ—*contd.*									
Megantereon (?) *palaeindicus* (Bose).	..	..	..	..	..	..	+	..	..
Sivaelurus chinjiensis, Pilgrim .	..	..	+	..	..	..	..	..	..
Vishnufelis laticeps, sp. nov. .	..	..	+	..	..	..	..	..	..
Felis subhimalayana, Bronn .	..	..	..	..	..	..	+	..	..
Felis chaus, *fide* Lydekker .	..	..	..	..	..	..	..	..	+
Felis rubiginosa, *fide* Lydekker .	..	..	..	..	..	..	..	..	+
Felis sp. indet	..	..	..	..	+	..	..	..	..
Felis sp. indet. . . .	..	..	..	..	+	..	..	..	..
Panthera cristata (Falconer and Cautley).	..	..	..	..	..	..	+	..	..
Panthera tigris or *leo*, *fide* Lydekker.	..	..	..	..	..	..	..	..	+
Panthera pardus, *fide* Lydekker .	..	..	..	..	..	..	..	..	+
Sivafelis potens, sp. nov. . .	..	..	..	..	..	..	+	..	..
Sivafelis brachygnathus (Lydekker).	..	..	..	..	..	..	+	..	..
HYÆNODONTIDÆ—									
Dissopsalis carnifex, Pilgrim .	..	..	+	..	..	..	..	..	..
Dissopsalis ruber, Pilgrim .	..	..	+	..	..	..	..	..	..

Correlation with European stages.—The bulk of the so-called 'Siwalik Fauna', which includes all the Carnivora here dealt with except the Narbada and cave species, was classed by Lydekker generally as Pliocene. The Kamlial beds of Sind and those of Perim Island were regarded as the oldest portion, with the exception of the Bugti deposits, now included in the Gaj, to which a possible Upper Miocene age was attributed. In several previous papers published between 1909 and 1926, I have discussed the question and I see no reason to alter the latest views which I have expressed (Pilgrim 1925, p. 202; *see also* below p. 8) except that I now feel no doubt that the Perim Island beds are the equivalent of the Dhok Pathan stage and not of the Nagri. The occurrence of large Giraffoids, a Pontian type of antelope and Proboscideans of Dhok Pathan affinities in Perim Island seems to fix its age beyond question, and I believe that Mr. A. T. Hopwood's study of the Proboscidea supplies ample confirmation of the correlation now advocated. A form like *Palæochœrus* (?) *perimensis* must be regarded as a mere relic of an earlier fauna.

Some comment is required on the views held by Matthew regarding the European correlation of the Siwalik faunas. Whether that author's opinion (Matthew 1929, pp. 438-439) that the Val d'Arno and Mont Perrier faunas of Europe are more appropriately placed in the Pleistocene be accepted or not, does not affect the question, since the equivalence of the fauna of the

Pinjor stage of the Upper Siwaliks to the two European faunas mentioned has not been disputed, and the Upper Pliocene age of the latter at present holds the field. Matthew's further attempt to shift upward the correlation of the Middle and Lower Siwalik stages involves a much more essential change. It is not always easy to gather what is his final opinion, but it seems to be condensed in the correlation table which he has published (Matthew, 1929, p. 441). I have elsewhere (Pilgrim 1931, pp. 151, 152, 155) tried to show the inadequacy of the arguments which Matthew has advanced in favour of correlating the fauna of the Dhok Pathan stage with European faunas of latter date than Pikermi. Without discussing at length the nature and affinities of the entire mammalian fauna of the Lower and Middle Siwalik, I cannot add much to the pages quoted. This is hardly the place to do this, even apart from the fact that much of the fauna still stands in need of a thorough revision. Matthew's main argument is based on the assumption that *Hipparion* appears in North America in beds which are the equivalent of the Pontian of Europe or but little earlier, hence its supposed occurrence at the top of the Chinji stage implies that that horizon is at any rate no earlier than Pikermi and that the Nagri and Dhok Pathan stages are later than Pikermi. Since Matthew, as I think correctly, regards the occurrence of forms like *Simocyon*, *Indarctos*, *Taxidea nevadensis*, *Heterofelis catocopis* and *Pseudœlurus intrepidus* var. *sinclairi*, as strong evidence for correlating the Upper Snake Creek and Rattlesnake formations of Nebraska and Oregon with the faunas of Pikermi, Samos, Maragha and that of Mongolia as described by Zdansky in 1924, there seems no reason why the Valentine and Ricardo formations, in which the earliest *Hipparion* occurs in America, should not be the equivalent of the Lower Chinji stage of India which marks a period before the arrival of *Hipparion* in that country.

Allowing for the distance and geographical barriers which separate Europe from India, the correspondence between Dhok Pathan forms and those of Pikermi and Samos is remarkable. The first appearance of large Giraffoids in both is all the more significant if, as Bohlin thinks, *Helladotherium* is a Sivatherine. The characteristic antelopine genus *Tragocerus*, closely allied forms of *Indarctos*, *Sivaonyx*, *Crocuta*, *Lycyœna*, *Ictitherium* and *Paramachœrodus* are found in both regions. The advent of what appear to be more modern types among the Bovinæ in the Dhok Pathan cannot be held to militate against the correlation, since India may have been near their original centre of distribution, but even in this case the new Bovine species *Parabos macedoniœ*, recorded by Arambourg and Piveteau (1929, p. 117) from Salonica and of *Ovis kuhlmanni* by Andree (1926, p. 172) from Samos seem to show that India had not the exclusive possession of Bovines and Bovine antelopes even in the Pontian.

Matthew, while admitting in part this correspondence between the Pontian faunas of Europe and the Dhok Pathan fauna of India, ascribes it on grounds which are by no means clear to me to the fact that these similar Indian species are post-Pontian relics of an earlier age. Apart from the circumstance that the agreement seems to be often too close for this explanation, yet other arguments against the hypothesis may be advanced. These I have already mentioned

(Pilgrim, 1931, p. 151) and I cannot do better than quote my previous words.

> 'If these allied forms are relics, then we have the choice of two alternatives: (1) either they must have migrated from the Holarctic region in Pikermi times and lingered on in India to a much later epoch; or (2) such migration did not take place until post-Pikermi times. If we adopt the first alternative we ought to find that the Nagri fauna and that of the uppermost Chinji, which on Matthew's hypothesis are the equivalent of Pikermi, contain Pikermi species or species at a similar stage of development; if the second alternative, neither the Nagri nor the Chinji fauna ought to contain any immediately ancestral types of the Pontian fauna of the Holarctic region. Actually, however, neither of these two things is true as regards the Carnivora nor, it may be said, other mammalian orders. We do not find Pikermi species at any earlier stage than Dhok Pathan, while the Nagri and, still more so, the Chinji stages contain species that are quite definitely ancestral to (or at any rate more primitive than) those of the Dhok Pathan and the Pontian of Europe alike.'

The best marked instances of this are perhaps seen in the Giraffoids, if, as I think, *Giraffokeryx* is an ancestor of the large branching-horned Sivatherines of the Pontian; in the Tragocerine and Gazelline antelopes; and in the Suoid phylum which leads from *Conohyus* to *Tetraconodon.* Amongst the Carnivora similar relations exist in the Hyænidæ between the Chinji *Crocuta carnifex* and the Pontian *Crocuta gigantea*, *Crocuta eximia* and *variabilis* and *Crocuta mordax*; between the Chinji *Lycyœna proava* and *chinjiensis* and the Pontian *L. macrostoma* and *chœretis*; in the Lutrinæ between the Chinji *Vishnuonyx* and the Pontian *Sivaonyx*; between *Eomellivora* (?) *necrophila* and Pontian Mellivorinæ; in the Felidæ between forms like *Sansanosmilus* (?) *serratus* and *Megantereon*; *Propontosmilus sivalensis* and *Epimachairodus* (?) *taracliensis* possibly also the Pontian genus *Paramachœrodus.*

The European equivalents of the various Indian stages, I consider to be approximately the following:—

Karnul cave deposits and Trichinopoly alluvium	Upper Pleistocene.
Narbada	Middle Pleistocene.
Boulder conglomerate	Lower Pleistocene.
Pinjor	Upper Pliocene (Mont Perrier and Val d'Arno).
Tatrot	Middle Pliocene (Montpellier).
Dhok Pathan	Pontian (Pikermi, Samos, Maragha, etc.).
Nagri	Sarmatian (Sebastopol and Csakvar).
Chinji	Upper Vindobonian (Grive-Saint-Alban).
Kamlial	Lower Vindobonian (Sansan).
Gaj (Bugti stage)	Lower Burdigalian.

Character of the Fossil Carnivorous Fauna of India.—So far as concerns the Pontian forms the relations between the Dhok Pathan fauna and those of Europe, China and North America have been discussed in a previous work (Pilgrim, 1931, pp. 152-155). That India formed a distinct zoological province appears certain, and it is in only comparatively few cases that its fauna touches those of the adjacent holarctic regions. This isolated character is less marked in the Chinji than in the Dhok Pathan stage, and if one knew more of the Carnivores of the Kamlial and Gaj, I think we might find that their affinities to those of Europe and Africa were rather close. The resemblances so far as concerns the Chinji fauna are of the nature of relics of a former fauna. That these exist in a very marked fashion in the Chinji and even persist into the Nagri and Dhok Pathan, can hardly be doubted, while archaic survivals are a feature of the Upper Siwalik and recent faunas of the Indian region; but this statement is by no means an admission that the whole fauna of each successive stage reproduces, as Matthew (1929, pp. 443, 452) claims, the character of an earlier stage in Europe and China, since a few close correspondences prove that contemporary interchange did occur. The most noticeable survivals in the Kamlial and Chinji are chiefly Felidæ, the curious form *Vinayakia, Hyainailouros,* Amphicnoninæ, and the Creödont *Dissopsalis.* In the Dhok Pathan Amphicyonines survive, while *Mellivorodon* and *Propontosmilus sivalensis* are probably representatives of early Proailurinæ and Machærodontinæ respectively.

The curious Chinji and Nagri Procyonid, *Sivanasua* finds a parallel only in the European Vindobonian form *S.* (=*Ailuravus*) *viverroides.* Neither stands in any close relation to the recent genus *Ailurus,* and they may be the highly specialised descendants of an ancient emigrant. Further discoveries are needed to throw light on their history.

In the presence of primitive Mellivorines India agrees with China and differs from Europe. The Chinji and Dhok Pathan Viverridæ may or may not be allied to those of Europe, but the family has certainly not been found in China, and its absence therefrom may be real. On the other hand the Lutrine affinities are nearer to European than Chinese forms. Curiously enough the Melinæ are apparently missing from the Indian faunas though an important constituent of those of Europe and China. The Hemicyoninae, represented by the genus *Indarctos*; the Hyænidæ represented by *Ictitherium, Lycyaena* and *Crocuta* (*C. eximia* type); and the Machærodontinæ, including not only *Paramachaerodus* but probably also *Machairodus* and *Epimachairodus,* form an important constituent of the Dhok Pathan stage of India and the Pontian of China and Europe. Ancestral forms of many of these groups, possibly of all of them, if the material supplied fuller evidence, occur in India, but from Europe primitive forms of *Crocuta, Lycyaena, Paramachaerodus, Machairodus,* and *Epimachairodus* are noticeably missing from pre-Pontian strata. Our ignorance of the Upper Miocene fauna of China does not allow us to say whether the Chinese fauna of that period was like that of India or not, but personally I anticipate that future discoveries will disclose more similarities in it to that of the Chinji and Kamlial stages of India than of the Vindobonian of Europe. On the other hand certain obvious North American migrants into China in Pontian times, especially the Caninæ, did not penetrate into either Europe or India as early as the Pontian.

By the period of the Pinjor stage, the North American Carnivores had reached India, and the modernised faunal facies of Europe and Asia had become widely spread. At the same time, as mentioned above, India retained many archaic forms, such as *Agriotherium*, *Hyaenictis*, *Enhydriodon* and *Vishnuictis*, after they had disappeared from other parts of Asia and Europe.

Treatment of the material.—Although the Carnivorous fauna of India is very rich, it is known only by extremely fragmentary material. Especially is this true of the Chinji stage. Much of it, though evidently of a strange type, does not really admit of adequate generic diagnosis. In the circumstances I have thought it wiser to refer it where possible to recognized and well distinguished genera, in preference to erecting new genera. Where this has not been possible, I have not hesitated to make new genera for the inclusion of it in order to simplify reference to the various forms in literature. Even when both these alternatives have been adopted, there remain a large number of specimens, of which, though evidently new, the generic or even the family reference is uncertain. Some of these I have figured in order to give some idea of the abundance of the fauna, and in case future finds elsewhere should render their identification probable. In these cases, however, I have in most cases refrained from naming them generically, even where I have, for convenience sake, given them a specific name. In some cases I have left both the genus and species indeterminate.

Anatomical nomenclature.—The English names current for the parts of the skull have been employed throughout. Osborn's cusp nomenclature has been used in the description of the molars, and the same terms have been used for the morphologically equivalent cusps of P^4. In describing the anterior upper premolars and the lower premolars, no actual names are used, but the cusp described is indicated merely by its position relative to the main cusp. No other points call for special notice, except that the measurement of the depth of the mandibular ramus adopted in this work is the distance from the base of the crown of M_1 on the inner side to the lower border, which is somewhat greater than that on the outer side.

SYSTEMATIC DESCRIPTION.

Sub-order: CREODONTA.

Diagnosis.—Primitive ancestral forms of the more modern Carnivora; of small to medium size; heavy, short-limbed, semiplantigrade or digitigrade, clawed, carnivorous or omnivorous animals; skull large; with sagittal crest; prominent muzzle; small brain-case entirely covered by the parietals; tympanic annular; auditory bulla not ossified; orbits widely connected with temporal fossa; skull contracted between them; lachrymal with a wide expansion on the face; feet small; digits five on pes and manus; humerus with entepicondylar foramen, generally with a third trochanter; scaphoid and lunar separate; os centrale free or fused with scaphoid; fibula strong, sometimes articulating with calcaneum; dentition $\frac{3\text{-}2}{3\text{-}2}.\ \frac{1}{1}.\ \frac{4\text{-}3}{4\text{-}3}.\ \frac{3\text{-}2}{3\text{-}2}$ originally with full dentition, reduced in most advanced members; tooth change late; canines and premolars well developed; molars of a similar type, but M^3 often a transverse tooth.

Family : *HYÆNODONTIDÆ.*

Diagnosis.—Creodonta with upper molars either three or reduced to two; two front upper molars specialised as carnassial teeth either tuberculo-sectorial or completely sectorial; last upper molar, when present, transversely extended; all the lower molars specialised as carnassial teeth; primitive forms with long and slender skull; tail long and heavy; later forms with more robust skull, claws blunt; cursorial adaptations to a varying extent.

Genus : DISSOPSALIS, Pilgrim.

1910. *Dissopsalis*, Pilgrim, *Rec. Geol. Surv. Ind.*, XL, p. 64.
1914. *Dissopsalis*, Pilgrim, *Op. cit.*, XLIV, p. 265, Pl. xxix, figs. 1-7.

Diagnosis.—Hyænodontidæ with complete molar and premolar dentition; upper molars with paracone and metacone separate but closer together than in *Sinopa*; protocone prominent, widely distant to the inside of the paracone and in advance of it; parastyle reduced; metastyle prolonged into a shear, most pronounced in M^2; M^1 with antero-posterior much in defect of transverse diameter; M^2 with antero-posterior much in excess of transverse diameter; M^3 much smaller then M^2 and situated almost wholly to the inside of it, with the shape of an isosceles triangle; P^4 almost as large as M^1, tritubercular; paracone a stout cusp, much larger than the metacone; parastyle absent or small; protocone a stout blunt cusp situated much to the inside of and slightly in advance of the paracone; P^3 longer than P^4 with a high main cusp, a well developed posterior accessory cusp and a rudimentary anterior accessory cusp surrounded by a strong cingulum, of which only a slight thickening represents the protocone of P^4; P^2 similar to P^3 but smaller; M_1 (referred mandible) with talonid as broad and almost as long as trigonid; strong protoconid, lower paraconid and still lower metaconid; talonid basin-shaped, with strong hypoconid, weak entoconid and low, transversely extended hypoconulid; P_4 much longer and broader than M_1 with a high main cusp, a well developed posterior accessory cusp and an internal cingular shelf, anterior accessory cusp small.

Genotype.—Dissopsalis carnifex, Pilgrim (1910, p. 64; 1914, p. 265).

Species.—In addition to the genotype a smaller species, *D. ruber*, came from the same locality and horizon.

DISSOPSALIS CARNIFEX, Pilgrim.

1910. *Dissopsalis carnifex,* Pilgrim, *Rec. Geol. Surv. Ind.*, XL, p. 64.
1913. *Dissopsalis carnifex,* Pilgrim, *Op. cit.*, XLIII, p. 311.
1914. *Dissopsalis carnifex,* Pilgrim, *Op. cit.*, XLIV, p. 265, Pl. xxix, figs. 1-4, 6.

Diagnosis.—A *Dissopsalis* without a parastyle in P^4, with a stouter and blunter protocone than in *D. ruber* and with a prominent intermediate cusp connecting it to the metacone; with diastemata between P^2 and P^3 and between P^3 and P^4.

Holotype.—The right maxilla with M^2-P^3 described and figured by Pilgrim (1915, p. 267, Pl. xxix, fig. 1). It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 143.

Referred specimens.—The left maxilla with P^3 and P^4 (G. S. I. no. D 144) figured by Pilgrim (1915, Pl. xxix, figs. 2, 2a).

The right P^4 (G. S. I. no. D 145) figured by Pilgrim (1915, Pl. xxix, figs. 4, 4a).

The right P^2 (G. S. I. no. D 146) figured by Pilgrim (1915, Pl. xxix, fig. 3).

The left mandibular ramus with P_4 and M_1 (G. S. I. no. D 142) described and figured by Pilgrim (1915, p. 274, Pl. xxix, figs. 6, 6a, 6b).

Locality.—The holotype and the referred specimens were collected at Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Remarks.—The holotype and the referred specimens have been fully described already by myself (Pilgrim 1915, pp. 265-279) and their probable affinities indicated. Nothing more need be added here. Matthew (1929, p. 457) mentions the existence of a specimen (? a skull) which was collected at Chinji by Barnum Brown and which is in the collection of the American Museum of Natural History in New York. This is as yet undescribed, but I gather that it supports the conclusions to which I was led by my study of the holotype and the referred specimens of *D. carnifex* and *D. ruber.*

DISSOPSALIS RUBER, Pilgrim.

1910. *Dissopsalis ruber,* Pilgrim, *Rec. Geol. Surv. Ind.*, XL, p. 64.
1914. *Dissopsalis ruber,* Pilgrim, *Op. cit.*, XLIV, pp. 268, 273, Pl. xxix, figs. 5, 5a, 7, 7a.

Diagnosis.—A *Dissopsalis* of somewhat smaller size than *D. carnifex*; P^4 with a distinct parastyle, protocone smaller and more pointed, not connected to the metacone by any intermediate cusp; P^3 with a more pronounced, almost cusp-like thickening of the cingulum on the postero-internal margin of the tooth; no diastemata between P^2 and P^3 nor between P^3 and P^4.

Holotype.—The left maxilla with M^2 and the broken M^3 described and, figured by Pilgrim (1914, p. 268, Pl. xxix, fig. 5). It is in the collection of the Geological Survey of India in Calcutta regd. no. D 147.

Referred specimen.—A left maxilla (G. S. I. no. D 148) with P^2-P^4 from Chinji, described and figured by Pilgrim (1914, p. 273, Pl. xxix, fig. 7, 7a).

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Remarks.—Both the holotype and the referred maxilla have been fully described by myself. The former differs only in size from the species *Dissopsalis* *carnifex*, but if as seems likely G. S. I. no. D 148 also belongs to the same species, the absence of diastemata between the premolars, the presence of a parastyle in P^4 and the more pointed and more median protocone are important distinguishing features. The only doubt is as to whether these are not of generic importance. Considering the fragmentary nature of the material of both species of *Dissopsalis*, generic separation does not seem to be warranted. Possibly the undescribed skull in the American Museum, New York may settle various points of the structure more satisfactorily.

Sub-order: ARCTOIDEA, Winge.

Diagnosis.—Carnivora with tympanic dish-shaped, furnishing the entire outer wall of the auditory bulla; bulla either with a septum, or chambered or cellular; carotid canal long; maxillo-turbinal large, branching, excluding the naso-turbinal and the upper ethmo-turbinal from the anterior nasal opening; os penis large; claws not retractile (except in *Ailurus*) (Weber 1928).

Family: *CANIDÆ*.

Diagnosis.—Arctoidea with a moderately high skull; brain-case not expanded; auditory bulla originally small, remote from the paroccipital process; this condition retained in the Amphicyoninæ but on other lines bulla becoming enlarged, inflated and brought into contact with the paroccipital process; alisphenoid canal present; dental formula $\frac{3.\ 1.\ 4.\ 3\text{-}2}{3.\ 1.\ 4.\ 3(4)\text{-}2}$; P^4 elongate, protocone prominent in early genera, later much reduced; M^1 3- or 4-tubercular, often with intermediate cusps, always broader than long, becoming progressively larger along many lines; M^2 similar, only very exceptionally lost; M^3 present in some early genera and in most of the Amphicyoninae, lost later; M_1 with metaconid strong in primitive genera and in the Amphicyoninae, progressively weaker along other lines; talonid with trenchant hypoconid, entoconid present either as a ridge, shelf or tubercles in the early genera and retained on most lines but lost in *Cyon*, *Icticyon* and their allies; M_2 long; M_3 only exceptionally lost in some highly specialised genera; digitigrade; primitive members with five digits, later forms with first digit both in manus and pes reduced.

Sub-family: *AMPHICYONINÆ*.

Diagnosis.—Canidae, with auditory bulla small, little inflated, remote from the paroccipital process; mastoid process prominent and broad; molars progressively enlarged, premolars and carnassials progressively reduced; upper molars tritubercular, with broad postero-internal shelf; M^3 and M_3 generally present but lost in advanced members; P^4 with progressively reduced protocone; M_1 generally with metaconid, talonid crested not bicuspid, M_2 with talonid crested not basin-shaped; limb bones massive; humerus with an entepicondylar foramen; manus and pes 5-dactyl.

Measurements of Indian Amphicyoninæ.

		Upper dentition.								Lower dentition.									
		Amphicyon pithecophilus type (G. S. I. no. D 129).	*Amphicyon* cf. *pithecophilus* (G. S. I. no. D 155).	*Amphicyon palæindicus* type (G. S. I. no. D 26).	*Amphicyon* cf. *shahbazi* (G. S. I. no. D 113).	*Amphicyon* cf. *shahbazi* (G. S. I. no. D 108).	*Arctamphicyon lydekkeri* type (G. S. I. nos. D 183, 134).	*Vishnucyon chinjiensis* type (G. S. I. nos. D 127, D 123).	*Melarctos* (?) *bugtiensis* type (Br. Mus. no. M 12838).	*Amphicyon* cf. *pithecophilus* (G. S. I. no. D 23).	*Amphicyon* cf. *pithecophilus* (G. S. I. nos. D 130, D 228).	*Amphicyon* sp. (D 132).	*Amphicyon* cf. *palæindicus* (G. S. I. nos. D 229, D 225, 226).	*Amphicyon shahbazi* type (G. S. I. no. D 110).	*Amphicyon* cf. *shahbazi* (Br. Mus. no. M 12340).	*Amphicyon* cf. *shahbazi* (G. S. I. no. D 247).	*Amphicyon sindiensis* type (G. S. I. no. D 25).	*Amphicyon* cf. *sindiensis* (G. S. I. no. D 257).	*Amphicyon cooperi* type (Br. Mus. no. M12341).
P_1	ant. post. diam.	..	..	..	..	..	..	..	..	..	..	..	..	app. 9	..	..	..	..	..
	trans. diam.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P_2	ant. post. diam.	..	..	..	..	..	..	..	..	..	..	..	..	app. 12	..	..	..	..	..
	trans. diam.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P_3	ant. post. diam.	..	..	..	..	..	..	..	..	..	..	..	..	14	..	..	..	..	..
	trans. diam.	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..
P_4	ant. post. diam.	..	..	..	..	33·6	..	23·6	22	..	..	..	..	21·5	..	..	..	..	..
	trans. diam.	..	..	..	..	18·5	..	12·1	13·5	..	..	..	..	13	..	..	..	..	..
M^1	ant. post. diam.	..	27·9	..	app. 28	..	21·3	21·1	16	33·0	..	..	31·0	30	31	..	..	..	32
	trans. diam.	..	36·3	..	34·5	..	30·8	24·2	19	15·1	..	..	11·9	18	14	11·6	..	..	16
M^2	ant. post. diam.	19-6	..	19·3	..	..	18·7	11·1	10	..	23·1	22·7	app. 21·7	20·5	..	..	19·9	app. 21·0	..
	trans. diam.	31-7	..	28·2	..	..	27·0	18·3	15	..	16·0	16·9	13·7	13	..	..	13·5	13·8	..
M^3	ant. post. diam.	..	..	..	..	..	..	..	..	..	16·0	..	13·0	..	..	..	app. 13	..	..
	trans. diam.	..	..	..	..	..	..	..	..	..	12·8	..	11·3	..	..	..	..	..	..

Genus: AMPHICYON, Lartet.

1836. *Amphicyon* Lartet, *Bull. Soc. géol. France*, VII, p. 219.

Diagnosis.—Amphicyoninæ with long skull; occiput narrow; muzzle elongated; anterior premolars slightly reduced and separated from one another; P^4 reduced as compared with the molars, with protocone far forward, parastyle weak or absent; M^1 and M^2 large, sub-triangular; M^2 only slightly smaller than M^1; M^3 always present but small; M_1 and M_2 slender, M_1 with strong metaconid, hypoconid crested, with a broad entoconid shelf; M_3 always present.

Genotype.—*Amphicyon major* Blainville (1841, Ostéographie, Subursus, Pls. xiv, xv), from the Vindobonian of Sansan.

Remarks.—Various species have been referred from time to time to this genus both in Europe and America. According to Matthew (1924, p. 104) 'many of these have but little in common with the type save the dental formula of M^3 and M_3. It is certain that the American Oligocene species referred here by Cope belong to other genera—*Daphaenus* and *Paradaphaenus*; and it appears highly probable that the species from the European Oligocene would also be distinguished if more fully known.'

Matthew (1918, p. 190) was originally inclined to separate all the American species generically or subgenerically and established a new genus *Pliocyon* with *P. medius* from the lower Snake Creek stage as genotype. In 1924 (p. 106) from a study of a fine skull of *Amphicyon amnicola*, Matthew and Cook, he came to the conclusion that this is a synonym of *A. sinapius*, Matthew from the Pawnee Creek, Colorado and not only differs from *Pliocyon medius* by characters of generic value but is a close ally of *Amphicyon major* 'differing from *Pliocyon* in the elongation of the muzzle, compression and spacing of the premolars, etc., as well as in the presence of M^3.' Matthew (1929, p. 481) considers that '*A. giganteus* is quite as likely to be *Pliocyon* as *Amphicyon*, but its generic position is uncertain. *A. lemanensis* should be compared with *Daphaenodon*. *A. ambiguus* etc., of the Phosphorites need comparison with *Daphaenus* and *Daphaenodon*; they are pretty surely not *Amphicyon*.'

Matthew's remarks lead one to suppose that the European material of most species of *Amphicyon*, which is available for comparison, is insufficient for generic determination. The specimens from India are undoubtedly too fragmentary to afford even as much scope for generic differentiation as those of Europe, so that they do not help in the solution of the problem. In the circumstances it does not seem feasible to do anything but include them under the general designation of *Amphicyon*. They all show at any rate specific differences from the described forms both in Europe and America.

The occurrence of small circular teeth, which seem to be M^3 of an Amphicyonine, in the Chinji stage at Chinji, indicate that at least one Indian species is not a *Pliocyon*. One of these teeth is figured in Pl. i, fig. 4 of the present work.

AMPHICYON PALÆINDICUS, Lydekker.

(Pl. I, figs. 9, 12.)

1860. *Amphicyon* sp., Falconer, Palæont. Mem., I, p. 416.
1876. *Amphicyon palaeindicus*, Lydekker, *Pal. Ind.*, (10), I, p. 84, Pl. vii, fig. 5.
1884. *Amphicyon palaeindicus*, Lydekker, *Op. cit.* II, p. 248, Pl. xxxii, fig. 8.

Diagnosis.—An *Amphicyon* of large size; M^2 smaller than in *A. major*; posterior border concave; antero-posterior diameter less, especially on the inner side; metacone reduced; protocone much reduced and less distinctly crescentic; external cingulum less marked than in *A. pithecophilus*; M_1 very compressed; paraconid, protoconid and hypoconid almost in the same straight line; metaconid small, much behind the protoconid; hypoconid high, trenchant; entoconid very low and narrow, not bifid. M_2 narrow, not tapering behind; cusps low; talonid slightly shorter than trigonid, but with very low cusps; entoconid more distinct than in *A. pithecophilus*; M_3 narrow, elongate with low cusps, talonid as long as trigonid but narrower.

Holotype.—The right M^2 described and figured by Lydekker (1876, p. 84, Pl. vii, fig. 5). This specimen is in Calcutta and is registered no. D 26 in the Geological Survey of India collection.

Referred specimens.—A fragmentary mandible (G. S. I. nos. D 225, 226) showing M_1 on both sides and M_2 and the root of M_3 on the left side, figured in Pl. i, figs. 7, 8 of this work, collected at Chinji in the Chinji stage.

An isolated M_3 (G. S. I. no. D 229) from the Chinji stage at Chinji figured in Pl. i, fig. 3 of the present work. This agrees in size with the base of the crown of M_3 which is left in the ramus no. D 226.

Locality.—The holotype was collected by Garnett and Trotter at Kushalgarh on the Indus. The referred mandible (D 225, 226) came from Chinji, as also the isolated M_3 (D 229).

Horizon.—The exact horizon of the beds at Kushalgarh are unknown, but their stratigraphical position leads one to infer that they were very low down in the Middle Siwaliks if not actually Lower Siwalik. This is supported by the occurrence amongst Garnett and Trotter's collections from Kushalgarh of a tooth of *Listriodon pentapotamiae* and *Dinotherium* and by the absence of typical Middle Siwalik species. The referred specimens certainly belong to the Chinji stage of the Lower Siwaliks.

Remarks.—Matthew (1929, p. 483, fig. 19) refers to this species an M^1 (G. S. I. no. D 155) from Chinji and a mandibular ramus (G. S. I. no. D 23) from Nurpur in the Kangra district, which Lydekker (1876, p. 84, Pl. vii, figs. 8, 12 ; 1884, p. 250, Pl. xxxii, fig. 5) had previously also referred to the same species. He, however, remarks that 'the M^1 is very large compared to the M^2 but this would conform to the rapid reduction in size of outer cusps in M^2 from front to back, so that they may belong to the same species despite the apparent incongruity. On the other hand the trigonid of the Nurpur M_1 seems small for the large M^1 although it registers well enough'.

It will be shown below (page 17) that a specimen of M^2 (G. S. I. no. D 129) was collected in the same season by Vinayak Rao from the same locality as the M^1 (D 155) described by Matthew. It cannot be asserted that they belong to the same individual though it is probable. In any case the M^2 differs considerably from the holotype of *A. palaeindicus*, and has the same crenulations on the wings of the protocone, absent in *A. palaeindicus*, which are present in D 155; also its greater transverse diameter is more in accord with the M^1. For these reasons I place them in a distinct species to which I give the name *Amphicyon pithecophilus*.

The Nurpur ramus seems more likely to belong to the latter species than to *A. palaeindicus* (see page 19), especially as another mandible (D 225, 226) has been found at Chinji, which is certainly different specifically from the Nurpur ramus, and which is less likely to have belonged to the large M^1 (D 155) on account of its slender teeth with lower cusps. I, therefore, provisionally refer this to *A. palaeindicus*. In this mandible M_1 is as long as in *A. pithecophilus*, but is more slender and the entoconid is narrower and lower. The cingulum of *A. shahbazi* is absent. M_2 differs from that tooth in *A. pithecophilus* in the fact that it does not taper posteriorly. From M_2 of *A. sindiensis* it is distinguished by the same character, and also by its greater size. It presents no closer resemblance to any of the European species of *Amphicyon* which approach it in size. Its measurements are included in the table on page 14.

AMPHICYON PITHECOPHILUS, sp. nov.

(Pl. II, figs. 1—4.)

1876. *Amphicyon palaeindicus*, Lydekker *pars*, Lydekker, *Pal. Ind.* (10), I, p. 84, Pl. vii, figs. 8,12.

1884. *Amphicyon palaeindicus,* Lydekker *pars,* Lydekker, *Pal. Ind.* (10), II, p. 250, Pl. xxxii, fig. 5.

1929. *Amphicyon palaeindicus,* Lydekker *pars,* Matthew, *Bull. Amer. Mus. Nat. Hist.,* pp. 482, 483, figs. 19, 20.

Diagnosis.—An Amphicyon of large size; upper molars with crenulated wings to the protocone; M^1 triangular, antero-posterior diameter of outer side less than in *A. giganteus,* outer cusps higher and more conical than in *A. major*; internal cingulum broad, flat, crenulated, antero-internally more developed than in *A. major,* less developed than in *A. giganteus* and *A. shahbazi*; external cingulum less developed than in *A. major* with a small posterior cusp, but without a median cusp; M^2 with transverse diameter greater relative to the antero-posterior diameter than in *A. giganteus* or *A. major*; external cingulum much stronger than in *A. giganteus* or *A. major*; posterior margin very concave.

M_1 with metaconid much lower than protoconid and placed much behind it; talonid with hypoconid taller and more trenchant than in *A. major* and more in a line with the protoconid and paraconid, entoconid a low bifid cusp; M_2 slighter and more tapering behind than in *A. major,* with lower entoconid; M_3 somewhat elongate with low cusps; talonid almost as long as trigonid.

Holotype.—The M^2 figured in Pl. ii, figs. 3, 3a of the present work. It is in Calcutta and is registered D 129 in the collection of the Geological Survey of India.

Referred specimens.—The M^1 (G. S. I. no. D 155) briefly described and figured by Matthew (1929, pp. 482, 483, fig. 19) under the name of *Amphicyon palaeindicus.* The same specimen is figured in Pl. ii, figs. 2, 2a of the present work. It was collected from the Chinji stage of Chinji in the same season as the holotype, and there is at any rate a possibility that it belongs to the same individual.

The right mandibular ramus from Nurpur (G. S. I. no. D 23) described and figured by Lydekker (1876, p. 84, Pl. vii, figs. 8,12; 1884, p. 250, Pl. xxxii, fig. 5) under the name of *Amphicyon palaeindicus.* It contains M_1 and mm_4. The middle portion of an M_1 (G. S. I. no. D 131) figured in Pl. ii, figs. 1, 1a of the present work, which seems to be identical with the Nurpur specimen was collected from the Chinji stage of Chinji.

A fragment of the left ramus showing merely the well preserved crown of M_2 (G. S. I. no. D 130) figured in Pl. ii, figs. 4, 4a, also from Chinji may be referred here.

Of two specimens of M_3, both single-rooted, from Chinji (G. S. I. nos. D 228 and D 229), the former, which is the larger, may be referred to this species. It is figured in Pl. i, figs. 2, 2a. All the measurements are tabulated on page 14.

Locality.—The type locality is Chinji, Salt Range. Most of the referred specimens come from the same locality, except the right ramus (D 23) which was collected at Nurpur in the Kangra district.

Horizon.—With the exception of the Nurpur ramus, the horizon of all the specimens mentioned above is known to be the Chinji stage of the Lower Siwaliks. The Nurpur beds from which the ramus was obtained agree in lithological character with those of Chinji (Pilgrim, 1913, pp. 268-270). They have been included in the Middle Siwalik (Pilgrim, *Rec. Geol. Surv. Ind.*, LV, p. 40 (1923)) but in any case seem to be on the boundary between the Lower and Middle Siwalik, so that the difference in age between the referred ramus and the Chinji specimens of *Amphicyon pithecophilus* can only be trifling.

Remarks.—The M^2 (D 129) has been chosen as the holotype in preference to the M^1 (D 155) because it alone can be compared with the holotype of *A. palaeindicus* (D 26). The two specimens are somewhat the same shape, but the transverse diameter of D 129 is greater, the outer cusps are taller, the metacone less reduced, the external cingulum is much stronger, the protocone has as prominent wings as in *Amphicyon major*, only they are crenulated (in D 26 the protocone is reduced and the wings of the crescent have almost disappeared); finally a prominent ridge descends from the summit of the protocone into the central hollow of the tooth, absent in D 26. The differences may to some extent have been accentuated by the weathering of D 26, but I cannot believe that they are not real.

At the same time Matthew's remark (1929, p. 483) that D 26 'is very notably different from M^2 of *A. major* so that I would be rather doubtful of its belonging to the genus' may be applicable, though in a less degree, to D 129, the holotype of *A. pithecophilus*. The smaller size of M^2 relative to M^1 (referred) and the excess of the transverse over the antero-posterior diameter distinguishes this tooth from the corresponding ones of both the large European species as well as from the M^2 from Pont-Levoy figured by Stehlin (1925, p. 36) and which he suggests may belong to the species *A. aurelianensis*, Mayet from the Sables de l'Orléanais, as also the concave outline of the posterior side. The external cingulum is stronger than in *A. giganteus* and much more so than in *A. major*.

As stated above (page 17), there are some grounds for supposing that the M^1 (D 155) belongs to the same individual as the holotype, but in any case the crenulated wings of the protocone and the tall outer cusps render it probable in the highest degree that they are specifically identical. The general outline is triangular, but slightly less so than in M^1 of *A. shahbazi* and still less so than in *A. giganteus*. The paracone and metacone are both strong and high, but the paracone is higher than the metacone. The protocone forms a much lower internal cusp, which is connected both with the paracone and the metacone by ridges containing two to three crenulations. The usual basin-shaped hollow is thus produced between the three main cusps. A broad, flat, crenulated cingulum exists on the inside, and half way round the posterior margin, being especially prominent at the postero-internal angle. On the outer half of the posterior margin it dies away entirely, and on the anterior margin is only faintly indicated. Externally there is a faint cingulum culminating in a minute cusp at the postero-external base of the metacone.

This tooth is smaller than M^1 in *A. giganteus* of the Sables de l'Orléanais, but is approximately the same size as in *A. major* of Sansan. It agrees with the latter in the postero-internal development of the cingulum, whereas in *A. shahbazi* of the Bugti Hills and *A. giganteus* the cingulum is less flat and extends with slightly diminished force all round the anterior side, joining up with the external cingulum. In *A. shahbazi,* instead of the cingulum passing up into the protocone a sort of furrow separates them. The weaker external cingulum also distinguishes M^1 in *A. shahbazi* from *A. pithecophilus.* Differences from *A. major* are: (1) in *A. major* a cingulum is altogether absent from the anterior side, while it can be faintly distinguished in *A. pithecophilus*; (2) the external cingulum is less strong in *A. pithecophilus* than in *A. major,* there being no median cusp, while on the other hand the posterior cingular cusp of *A. pithecophilus* is not present in *A. major*; (3) the ridges connecting the protocone to the outer cusps in *A. major* lack the crenulations which are so marked in *A. pithecophilus.*

Lower dentition.—The immature right mandibular ramus from Nurpur (D 23), was described and figured by Lydekker (1876, p. 84, Pl. vii, figs. 8, 12 ; 1884, p. 250, Pl. xxxii, figs. 5, 5a), who provisionally referred it to the same species as the M^2 from Kushalgarh, the holotype of *Amphicyon palaeindicus.* Matthew (1929, p. 483) remarks that the trigonid of M_1 seems small for the large M^1. I am inclined to think that of the two Amphicyonine mandibles known to us from the Chinji stage, the Nurpur one as the larger and more robust one with higher hypoconid is more likely to go with the holotype M^2 and the referred M^1 of *A. pithecophilus* than with the smaller M^2 of *Amphicyon palaeindicus.* It may be noted that a fragmentary M_1 (D 131) figured in Pl. i, figs. 1, 1a of the present work has been found at Chinji. It seems to be identical with M_1 in the Nurpur ramus.

The M_1 is approximately the same size as in *A. major,* but the hypoconid is taller, more trenchant, and stands more nearly in the same line as the cusps of the trigonid, which form a more open angle than in either of the European species or than in *A. shahbazi.* The entoconid is a low, bifid cusp, whereas the typical *A. major* has a single broad cusp. I have, however, seen a specimen in the Paris Museum referred to *A. major,* in which the entoconid is also bifid. In *A. aurelianensis* Mayet (Mayet 1908, p. 214), which is not at all inferior in size to the Indian specimen, the metaconid of M_1 is lower. M_1 in *A. shahbazi* differs by the entoconid being merely a flat shelf with a crenulated edge and a more marked external cingulum. *A. giganteus* differs from *A. pithecophilus* in precisely the same way as *A. shahbazi,* except that the external cingulum is even less strong than in *A. shahbazi.*

A fragmentary left ramus (G. S. I. no. D 130) figured in Pl. ii, figs. 4, 4a of the present work has been found at Chinji. It shows merely the well preserved crown of M_2, which agrees well in size both with the Nurpur M_1 as well as with the M_2 of *A. aurelianensis* the size of which is known by its alveoli. It is smaller than the M_2 of *A. major* and is proportionately more slender; moreover it tapers sensibly behind, and the entoconid appears to be flatter. Lydekker (1884, p. 251, Pl. xxxii, fig. 4) has referred to this species a right ramus (G. S. I. no. D 25) from the Kamlial horizon of Sind. M_2 in this ramus shows much the same features as the Chinji M_2, but it tapers even more posteriorly as shown by the more oblique position of the hypoconid; it is also considerably smaller.

Moreover the alveoli of M_3 show that this was a double-rooted tooth unlike any specimens of M_3 found at Chinji. On account of these differences I am inclined to separate it specifically from *A. pithecophilus* under the name of *A. sindiensis.* It was probably a direct ancestor of that species.

The inner half of an M^1 collected by Mr. C. Forster Cooper in the Gaj series of the Bugti Hills (Br. Mus. no. 10497) is figured by Matthew (1929, p. 482, fig. 18). It certainly resembles very closely the corresponding part of *A. pithecophilus,* and may belong to a closely allied or ancestral species, but without more material it is difficult to draw any conclusions of real value.

The only three European species with which *A. pithecophilus* can be compared are *A. major, A. giganteus* and *A. aurelianensis.* In size it agrees most nearly with *A. aurelianensis,* but much the same difference of structure exist in relation to that species so far as it is known, as in the case of *A. major,* which approaches it next nearly. The most striking difference is found in M^2, one specimen of which is fortunately the type, since it is by no means certain that all the specimens described above belong to one and the same species.

Cooper (1923, p. 259) has referred to the same species as the Nurpur ramus (D 23) an M_1 from the Gaj horizon of the Bugti Hills which, however, seems to differ in many details of structure, so that I have decided to separate it under the name of *A. cooperi* (page 23). Its much earlier horizon also militates against specific identity.

AMPHICYON SHAHBAZI, Pilgrim.

(Pl. I, fig. 10; Pl. II, fig. 6; Pl. III, fig. 1.)

1912. *Cephalogale shahbazi*, Pilgrim, *Pal. Ind.*, N. S., IV, Mem. 2, p. 11, Pl. iii, figs. 1, 2.
1912. *Amphicyon* sp. cf. *major*, Pilgrim, *Ibid.*, p. 10, Pl. i, fig. 4.
1912. *Pterodon,* sp., Pilgrim, *Ibid.*, p. 9, Pl. i, fig. 2.
1913. *Amphicyon shahbazi*, Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, p. 75.

Diagnosis.—An *Amphicyon* of slightly smaller size than *A. pithecophilus*; M^1 with antero-posterior diameter of outer side greater than in *A. pithecophilus*, with lower and more compressed outer cusps; internal cingulum ridge-like, separated by a furrow from the protocone, extending right round to the anterior side of the tooth; external cingulum present, but weaker than in *A. pithecophilus* or *A. major*; mandible rather short, deep and stout, with anterior premolars less reduced than in *A. sinapius* and rather crowded; M_1 stouter than in *A. pithecophilus*; paraconid more oblique; hypoconid lower and more external; entoconid shelf broader; strong external cingulum; M_2 shorter than in *A. pithecophilus* and *A. major*; paraconid present; metaconid smaller; hypoconid higher than in *A. major*; talonid more basined with a crested entoconid; M_3 shorter and more rounded than in *A. major.*

Holotype.—The right mandibular ramus described and figured by Pilgrim (1912, p. 11, Pl. iii, fig. 1) under the name of *Cephalogale shahbazi* and subsequently referred to the genus *Amphicyon* (Pilgrim 1913, p. 74). This is in Calcutta, G. S. I. regd. no. D 110.

Referred specimens.—The right mandibular ramus (G. S. I. no. D 111) containing the hinder part of M_1, M_2 and the alveolus of M_3, described and figured by Pilgrim (1912, p. 11, Pl. iii, figs. 2, 2a) under the name of *Cephalogale shahbazi* and subsequently referred to the genus *Amphicyon* (Pilgrim, 1913, p. 74).

The M^1 (G. S. I. no. D 113) described and figured by Pilgrim (1912, p. 10, Pl. i, fig. 4) under the name of *Amphicyon* sp. cf. *major* and subsequently referred (Pilgrim 1913, p. 75) to *Amphicyon shahbazi.* This is refigured in the present work (Pl. ii, figs. 6, 6a).

The right maxilla (G. S. I. no. D 108) containing P^4 and the broken roots or alveoli of M^1, described and figured by Pilgrim (1912, p. 9, Pl. i, fig. 2) under the name of *Pterodon* sp. This specimen is refigured in the present work (Pl. i, fig. 10). Its dimensions are included with those of the holotype and others of the referred specimens in the table on page 14.

An M_1 (G. S. I. no. D 247) from the Lower Murree stage, 3½ miles north of Basal, Attock district is figured in the present work (Pl. iii, fig. 1).

Several imperfect mandibular fragments from the Gaj horizon of the Bugti Hills have been described and figured by Cooper (1923, pp. 261, 262) under this name. These vary slightly in size and character, but except for the one (Br. Mus. no. M 12341) figured by Cooper (1923, p. 260, fig. 1B) under the name of *Amphicyon palaeindicus,* all of them have been referred to *A. shahbazi.* Br. Mus. no. M 12341 is in the present work made the type of a new species *Amphicyon cooperi.* The remainder are not considered by Matthew (1929, p. 485) as likely to be all the same species, but 'are all rather nearly related'. With the exception of the holotype of *A. cooperi* it seems advisable to follow Matthew's example and group them all provisionally under the designation of *A. shahbazi.*

Locality.—The holotype and most of the referred specimens come from the Bugti Hills, Baluchistan. G. S. I. no. D 247 is the only one from a different locality, this having been collected 3½ miles north of Basal in the extreme north of the Salt Range area.

Horizon.—The Bugti stage of the Gaj series, believed to be the equivalent of the Fatehjang or lowest stage of the Murree series in the Salt Range, from which G. S. I. no. D 247 was collected.

Remarks.—The holotype, which was described and figured by myself (Pilgrim 1912, p. 11, Pl. iii, fig. 1) is the most complete mandible of the species known. The preservation of M_1 and M_2, it is true, leaves much to be desired, but its deficiencies in regard to this are amply supplied by the right ramus (G. S. I. no. D 111) which was figured in the same work (Pl. iii, figs. 2, 2*a*) and by the M_1 figured by Cooper (1923, p. 260) from the same beds. It was the latter specimen which caused me to reject my first attribution of the species to *Cephalogale* (Pilgrim 1913, p. 75). It cannot be reasonably doubted that both of these belong to the same species as the holotype.

The species is characterised so far as concerns the mandible by the relative shortness and great depth of the ramus, its massive structure, the stoutness of both molars and premolars, the unreduced premolars and their rather crowded position in the jaw, with only a short diastema behind the canine. In size it probably did not differ greatly from *Amphicyon major,* though it must have been a more robust animal, and in all the characters mentioned above it differs markedly from the Sansan species, and it may well belong to another genus than *Amphicyon,* though it does not at present seem desirable to take the course of making for it a new genus. It does not seem any nearer to the genus *Pliocyon.* The mandible of the genotype of *Pliocyon, P. medius,* is unknown, but if Matthew (1924, p. 113) is right in assigning the species *Dinocyon gidleyi,* Matthew (1902, p. 129) to the genus *Pliocyon,* then the premolar series of the latter is very much more reduced, although the jaw is no shorter through the presence of diastemata between the teeth. As Matthew (1929, p. 483) has suggested, the resemblance to *Amphicyon frendens* seems to be closer in regard to the size and spacing of the premolars, but apparently in that species the entoconid in both M_1 and M_2 is less broad than in the Bugti species.

I am imperfectly acquainted with the mandible of *Amphicyon giganteus,* but if the upper molar (G. S. I. no. D 113) figured by Pilgrim (1912, Pl. i, fig. 4) and refigured in the present work (Pl. ii, fig. 6) is correctly attributed to the species *A. shahbazi,* then its structure approximates more nearly to that of the corresponding tooth of *A. giganteus* than of *A. major.* In size it falls behind the European species from Avarez and the Sables de l'Orléanais but the fact that the cingulum continues right round the tooth constitutes a difference from *A. major,* which according to Mayet (1908, p. 213) is equally shown by *A. giganteus.* The external cingulum, which is strong in *A. major,* but is scarcely indicated in *A. giganteus,* is present in *A. shahbazi* though less strong than in *A. major.* M_1 has an equally close resemblance to the corresponding tooth of *A. giganteus.* An internal crenulate cingulum passes round into an external cingulum which is, however, stronger in the Bugti tooth. The entoconid is lower both in *A. shahbazi* and in *A. giganteus* than in *A. major.* The Bugti tooth is rather more slender than that of the Sables de l'Orléanais species and the paraconid is slightly longer. No comparison is possible with M^2, since this tooth is unknown in *A. shahbazi.*

The maxilla (G. S. I. no. D 108) is extremely likely to belong to the species *A. shahbazi.* The P^4, which is the only tooth preserved, is precisely the same length as that of the maxilla of *A. major* figured by Blainville (Subursus, Pl. xiv), but it is rather stouter, which accords with the teeth in the holotype of *A. shahbazi.* The protocone has just the shape, the very forward position and the small inward extension, which we find in *Amphicyon.* In the figure the parastyle seems to be more distinct than is actually the case. It is not represented by any definite cusp any more than is the case in *A. major,* but the base of the crown just in front of the broken outline of the paracone is somewhat expanded to form a kind of cingulum, which does not, however, reach as far forward as the protocone. There is also a slight internal cingulum. The three roots of M^1 are in part visible forming a triangle of which both the size and the outline correspond very well with the isolated M^1 (G. S. I. no. D 113) figured in Pl. ii, fig. 6. I am not acquainted with the corresponding P^4 of *A. giganteus.* Since the available material of both the Indian and the European species is too inadequate for a full comparison, the exact degree of relationship of the two species must remain in doubt

AMPHICYON COOPERI, sp. nov.

1923. *Amphicyon palaeindicus,* Cooper, *Ann. Mag. Nat. Hist.,* London, (9), XII, p. 259, text fig. 1 B.

1929. *Amphicyon* aff. *palaeindicus* ? Matthew, *Bull. Amer. Mus. Nat. Hist.,* LVI, p. 484.

Diagnosis.—An *Amphicyon* of large size; M_1 with paraconid more oblique than in *A. pithecophilus,* taller, longer and stronger; metaconid less robust; hypoconid lower and less trenchant; entoconid shelf with a bifid cusp but broader; posterior end with a rather square outline; no external cingulum.

Holotype.—The M_1 described and figured by Cooper (1923, p. 259, text fig. 1 B) under the name of *Amphicyon palaeindicus.* This is in the British Museum regd. no. M 12341.

Locality.—The Bugti Hills, Baluchistan.

Horizon.—The Bugti stage of the Gaj series.

Remarks.—The holotype was referred by Cooper to the same species as the Nurpur ramus (G. S. I. no. D 23), classed in this work as *A. pithecophilus,* mainly because of the bifid entoconid. There are, however, so many differences between the two specimens of M_1, that, considering how little the various species of *Amphicyon* differ from one another in regard to the structure of this tooth, I think that these differences must be regarded as specific. The bifid entoconid is perhaps only an individual variation, since although this cusp is not bifid in the typical *A. major,* I have seen a specimen of this species in Paris, in which the structure of the entoconid of M_1 exactly reproduces that of the Nurpur and Bugti teeth. In fact in spite of Matthew's opinion (1929, p. 484) it seems to me that this tooth more nearly resembles the corresponding one of *A. shahbazi* than of *A. pithecophilus,* except for the absence of an external cingulum. It is even possible that it may be only a variety of *A. shahbazi.*

AMPHICYON SINDIENSIS, sp. nov.

1884. ? *Amphicyon palaeindicus, pars* Lydekker, *Pal. Ind.,* (10), II, p. 251, Pl. xxxii, fig. 4.

Diagnosis.—An *Amphicyon* with M_2 considerably smaller than in *A. pithecophilus,* elongated but narrower behind than in front; M_3 double-rooted, elongated.

Holotype.—The right mandibular ramus containing M_2 and the alveolus of M_3 described and figured by Lydekker (1884, p. 251, Pl. xxxii, fig. 4) and provisionally referred by him to *Amphicyon palaeindicus.* It is in the collection of the Geological Survey of India in Calcutta regd. no. D 25.

Locality.—Sind.

Horizon.—Probably from the basal beds of the Lower Manchhar series, which belong to the Kamlial or lowest stage of the Lower Siwaliks.

Remarks.—Lydekker had hardly any other course open to him than to refer the holotype provisionally to the species *A. palaeindicus.* At that time the only other Amphicyonine mandible known from India was the Nurpur ramus, in which there was nothing to show what was the size or shape of M_2 or M_3. Now, however, we are acquainted with a mandible from Chinji containing M_3 (G. S.

I. nos. D. 225, 226) as well as with isolated specimens of M_2 and M_3 from the Chinji stage, found in localities, which have yielded specimens of M_1 apparently identical with that in the Nurpur ramus and also upper molars which have been taken as the types of *Amphicyon pithecophilus.* There is little doubt that the Sind M_2 is not identical with the specimens of M_2 from Chinji figured in Pl. i, fig. 9 ; Pl. ii, figs. 4 and 5, as it is considerably smaller, although in other respects it is not unlike the one figured in Pl. ii, fig. 4 (G. S. I. no. D 130). Further there are specimens of M_3 from Chinji (G. S. I. nos. D 228 and 229) which have only a single root, unlike the Sind specimen which is double-rooted. The corresponding tooth in *Amphicyon major* and *giganteus* as well as in *A. shahbazi* was small and single-rooted. Mayet (1908, p. 216), observes that M_3 in *Amphicyon aurelianensis* from the Sables de l'Orléanais was probably double-rooted. It is larger than the Sind one, but further comparisons are impossible as the actual teeth are not preserved in Mayet's type mandible. The posterior tapering of the Sind M_2 distinguishes it from European species, which agree with it in size. It is not impossible that it may be a small race of *Amphicyon aurelianensis,* but in the absence of additional evidence it seems better to distinguish the Sind species by provisionally giving it a specific name of its own. The length of the alveolus of M_3 in the Sind specimen is 13 mm. while the length of M_2 is 19·9 mm.

Genus : ARCTAMPHICYON, nov.

Diagnosis.—Amphicyoninæ with transversely extended upper molars, but with inner border of M^1 only slightly shorter than outer border; crown lower and more flattened than in *Amphicyon,* with all the cusps lower; paracone much stronger than metacone; inner cingulum crenulated, very broad and just as strongly developed on the anterior as on the posterior side, continuing in an outward direction so as almost to join up with the external cingulum; external cingulum strong; M^2 smaller than M^1, with more reduced metacone and with internal cingulum much less strongly developed and forming more of a rim at the edge of the crown, but otherwise resembling it.

Genotype.—Amphicyon lydekkeri, Pilgrim (1910, pp. 64, 199).

ARCTAMPHICYON LYDEKKERI, Pilgrim.

(Plate II, figs. 7, 8.)

1910. *Amphicyon lydekkeri,* Pilgrim, *Rec. Geol. Surv. Ind.,* XL, pp. 64, 199.

1929. *Amphicyon lydekkeri,* Pilgrim, Matthew, *Bull. Amer. Mus. Nat. Hist.,* LVI, p. 481, text fig. 18.

Diagnosis.—This is the only species known and the diagnosis is that of the genus.

Holotype.—The upper molar, believed to be M^1, briefly described by Pilgrim (1910, p. 199) and more fully described and figured by Matthew (1929, p. 481, text fig. 18). This is figured in Pl. ii, fig. 7 of the present work. It is in Calcutta G. S. I. regd. no. D. 133.

Referred specimen.—A second upper molar (G. S. I. no. D 134), believed to be M^2, figured in Pl. ii, fig. 8.

Locality.—Near the village of Padhri, which adjoins that of Hasnot, Salt Range. Both specimens are believed to have been found in the same spot.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Remarks.—Matthew observes (1929, p. 481) 'the cast of the type is actually that of M^2'. If the holotype be viewed as an isolated specimen there is no doubt that Matthew's opinion could only be regarded as correct. Both the specimens are, however, believed to have been found in the same spot, and this is borne out by their identical colour and state of fossilisation. The smaller size and less advanced stage of wear of D 134 would correspond to a more backward position in the maxilla than D 133, so that the circumstances point to the teeth in question being M^1 and M^2 of one and the same individual, which is the view adopted here. The possibility can, however, by no means be excluded that their supposed association and state of wear are due to chance, and that they are both of them M^2 of Amphicyonines. In that case they must belong to two different species, both of them more closely allied to the genus *Amphicyon* than would be the case if we regard the teeth as M^1 and M^2 of the same individual. Even in that case it is likely, as Matthew points out, that they are generically different from *Amphicyon,* but according to the view taken here, the ursoid resemblances are still more marked.

The great excess of the transverse over the antero-posterior diameter, the broad internal cingulum and the crescentic wings of the protocone are characters of the Amphicyoninæ which are not possessed either by *Dinocyon* or any member of the Hemicyoninæ, although they approach them in some degree. The holotype, which is much smaller than M^1 of *A. major, A. pithecophilus* or *A. shahbazi,* is quadrangular, not triangular as in all known species of *Amphicyon,* the inner border being only slightly shorter than the outer border. *Amphicyon frendens* Matthew seems to approach this condition more nearly than other species of *Amphicyon.* It is, however, more characteristic of *Hemicyon* and *Agriotherium*; in these genera, however, the internal lengthening of the tooth is due to the extension of the internal cusps in an antero-posterior direction rather than of the cingulum as is the case in the Padhri tooth. The paracone and metacone are both low cusps, the paracone being much stouter than the metacone. The protocone is a low conical cusp connected with the outer cusps by ridges, which are much worn. The space between these ridges is not strongly concave as in *A. pithecophilus* and most other species of *Amphicyon*, but is almost flat. The whole inner margin of the tooth is surrounded by a broad crenulated cingulum on to which some two or three ridges run down from the summit of the protocone. In *Amphicyon* on the contrary the cingulum is much more developed on the postero-internal corner and often dies away altogether on the anterior cornes. The cingulum continues practically all along both anterior and posterior margins and unites with the external cingulum. This is also extremely strong, especially at the two corners.

The smaller of the two teeth (D 134), if it were as much worn as the holotype, would probably be almost identical with it, except for its smaller size, the weaker metacone and the narrower internal cingulum which is somewhat less flat than in the holotype and forms more of a rim at the edge of the crown. Its unworn crown permits the wings, which connect the protocone to the outer cusps, to be well seen. A weak additional ridge runs from the summit of the protocone to the centre of the tooth. The dimensions of both specimens are in the table on page 14.

Genus: VISHNUCYON, nov.

Diagnosis.—Amphicyoninae of small size; M^1 triangular in shape, approximately equilateral; external antero-posterior diameter great; transverse only slightly exceeding antero-posterior diameter; internal cingulum rather prominent, chiefly developed at the postero-internal corner; external cingulum variably developed; paracone rather high; metacone much lower; protocone well marked but rather low with low, slightly crenulated wings, connecting it to the outer cusps; no hypocone; M^2 sub-rectangular in shape; much smaller than M^1; antero-posterior diameter only half that of M^1; transverse diameter more than half as large again as the antero-posterior diameter; internal cingulum well developed, equally on the anterior and posterior corners; external cingulum absent; outer cusps much reduced in height; metacone much smaller than paracone; protocone well marked but low, connected by faintly indicated wings to the outer cusps; P^4 with antero-posterior diameter considerably less than that of the united M^1 and M^2; protocone extremely weak, reduced to a minute cusp; no parastyle; paracone and metacone fairly high, sub-equal trenchant blades.

Genotype.—*Vishnucyon chinjiensis*, sp. nov. described below and figured in Pl. ii, figs. 9, 9*a*, 9*b* of the present work.

VISHNUCYON CHINJIENSIS, sp. nov.

(Plate I, fig. 4; Pl. II, fig. 9.)

Diagnosis.—This is the only species known and the diagnosis is that of the genus.

Holotype.—The left maxilla containing M^1 and M^2 figured in Pl. ii, figs. 9, 9*b* of the present work and in the collection of the Geological Survey of India in Calcutta regd. no. D 123.

Referred specimens.—It is believed that another fragment of a left maxilla containing P^4 (G. S. I. no. D 127), collected at Chinji by Vinayak Rao in the same season as the holotype, belongs to the same maxilla as the latter. It is not known for certain now whether they came from the same spot or not, but this is assumed to be the case since I find, on clearing both the fragments of the matrix which covered the fractured surfaces, that they fit precisely into one another, but not quite cleanly. Since the line of fracture contains a right angle, the fit cannot be passed over as a mere coincidence. Consequently it is almost certain that the two fragments belong to the same individual though slight doubt on the point is admissible. In any case the inner wall of the alveolus of the hinder root of P^4 which is present in the type fragment, shows that the position of the three teeth is as represented in the figure (Pl. ii, fig. 9). An isolated right M^1 from the same horizon and locality (Br. Mus. no. M 12970), though very slightly larger than the type, undoubtedly belongs to the same species.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The dimensions of all the teeth in the maxilla are included in the table on page 14. M^1 is a triangular tooth, almost equilateral in shape. It has an Amphicyonoid configuration of the crown, but the antero-posterior diameter along the external border is very much greater in proportion to the breadth than in any one of the Amphicyoninæ known. The paracone is rather high; the metacone almost as stout, but little more than half the height of the paracone. The protocone is well developed, but much lower than either of the other two main cusps; connected by two low ridges to the lateral edges of the outer cusps; both these ridges are slightly crenulated. An internal cingulum, rounded, and separated by a furrow from the protocone, fairly strong at the postero-internal corner, continues half way along the anterior and the posterior margins, but is absent for the outer half. External cingulum represented on the holotype midway between the paracone and metacone, but absent on the second specimen of M^1 (Br. Mus. no. M 12970) except for a very faint swelling.

M^2 much smaller than M^1; almost rectangular in outline; paracone long and low; metacone distinctly indicated, conical, a little lower and much smaller than the paracone; protocone well-marked but low, connected by faintly indicated ridges to the outer cusps. Internal cingulum, strong, rounded, separated by a furrow from the protocone, not confined to the postero-internal corner but continuing right round the inside of the tooth and dying away half way along the anterior and posterior margins. External cingulum practically absent. P^4 is not much longer than M^1. Metacone with a cutting edge, as long as the paracone but less stout. Protocone represented by a minute cusp on the antero-internal base of the paracone, continued into a cingulum all along the internal margin. There is also a slight external cingulum.

It is not quite certain whether M^3 was present or not. There is no sign of any root or alveolus in the portion of the maxilla posterior to M_2, nor is there any facet of pressure on the hinder edge of M^2. The margin of the maxilla is, however, broken away in great part, so that the evidence against its presence is unsatisfactory. On the other hand an isolated tooth from Chinji (G. S. I. no. D 230) figured in Pl. i, figs. 4, 4*a* which seems to be an Amphicyonoid M^3 is probably too small for any of the species of *Amphicyon*, but might belong to the present species. This is approximately circular in shape, with a low crown consisting of an inflated rim flattening somewhat on the upper surface and enclosing a circular cavity. Here and there the edge of the rim bounding the cavity is slightly indented.

Comparisons.—That the specimens belong to one of the Canidæ is evident. The indications which might lead us to place it in one of the sub-families rather than another are, however, conflicting. The small antero-posterior diameter of

P^4 relative to that of M^1 and M^2 is a character which the species shares with the Amphicyoninæ and the Caninæ. Such a reduction of P^4 is not known in any member of the Lycaoninæ. On the other hand the small size of M^2 and the great external diameter of M^1, almost equal to the transverse diameter of the same tooth militate against the inclusion of the species among the Amphicyoninæ. In *Amphicyon ambiguus,* where M^2 is small and M^3 absent, the transverse diameter is as great as in other species of *Amphicyon. Pseudamphicyon lupinus* approaches this species somewhat in the reduction of M^2 but the strong external cingulum gives the molars of that species quite a different appearance, while the small protocone in P^4 of the Indian form is quite unlike the large one of *Pseudamphicyon lupinus.* Even in the advanced and rather aberrant Amphicyonine genus *Simocyon* (*see* Pilgrim 1931, p. 8), in which M^3 is lost and P^4 is less reduced relatively to the upper molars than in other members of the Amphicyoninæ, the greater transverse diameter of the upper molars is an Amphicyonine character which the Indian fossil form does not exhibit. P^4 is also very different in *Simocyon,* because of the strong parastyle (absent in *Metarctos*) and the well developed protocone.

Both in the reduction of M^2 as well as of P^4 a resemblance to the Caninæ may be traced, but the absence of a postero-internal cusp (hypocone) in M^1 distinguishes it from that sub-family. Further in no member of it is the antero-posterior diameter of M^1 so great as in the Indian fossil.

Except for the great reduction in length of P^4 relative to the molars, it is possible that a closer alliance might be found in the modern genus *Cyon,* and the John Day Lower Miocene genus *Temnocyon,* which Wortman and Matthew (1899, p. 115) consider to be on the ancestral line of *Cyon.* The reduction of M^2 is about the same in *Temnocyon* and the Indian fossil species ; in *Cyon* it is much more advanced. On the other hand the external antero-posterior diameter of M^1 is greater in the Indian fossil species than in *Temnocyon,* producing a triangular instead of a rectangular shape ; in *Cyon* this dimension is even greater, but the transverse diameter is relatively much less, chiefly because in the living form the internal cingulum is absent, though as well developed in *Temnocyon* as in the Chinji species. In *Temnocyon* there is also a strong external cingulum of which the Indian fossil shows little trace. As remarked above P^4 is more reduced in the latter than in either of the genera with which I have compared it, but it bears a closer resemblance to *Cyon* because of the small protocone, though this is even smaller than in *Cyon.*

A palate and mandible were described by Matthew (1902, p. 285) from the Upper Miocene of Colorado under the designation of ?*Cyon* or *Icticyon* sp. These contain only the milk dentition, but Matthew suggested that the species may represent an intermediate stage between *Temnocyon* and *Cyon.* In the event of further material becoming available, a comparison of this form with the Chinji genus might be profitable.

It seems evident from the characters which are shown by our specimen that it differs generically from any Canid form with which I am acquainted, but through our regrettable ignorance of the characters of the skull and the lower dentition, we receive no help in attempting to reconcile the conflicting evidence derived from the upper carnassial and the two molars, which are alone known. I am inclined to lay more stress on the general shape of M^1 and the reduction of P^4 than on the Lycaonine features which I have shown that it possesses, so that I provisionally class the genus *Vishnucyon* (the name by which I propose that it should be known) amongst the Amphicyoninæ, but whether it be genetically related to that sub-family or to the Lycaoninæ, it seems certain that like *Simocyon* it represents a very aberrant stock which had its roots far back at a time when the Canid sub-families were less differentiated than they became later.

METARCTOS (?) (or an allied genus) BUGTIENSIS (Cooper).

1923. *Cephalogale, bugtiensis*, Cooper, *Ann. Mag. Nat. Hist. London*, (9), XII, p. 262 text fig. 2.

Holotype.—The left maxilla containing the broken P^3, P^4, M^1 and M^2, described and figured by Cooper (1923, p. 262, fig. 2). It is in the British Museum regd. no. M 12338.

Locality.—The Bugti Hills, Baluchistan.

Horizon.—The Gaj series (Bugti stage).

Remarks.—The measurements of the holotype are included in the table on page 14. Cooper in describing it remarked that its generic position could not be determined with certainty, but that 'the small size of P^3 and the curvature of the hinder part of the dental series suggest one of the short-nosed genera'. The forward position of the protocone of P^4 and the triangular outline of M^1 more extended transversely and without a hypocone, make it, however, quite unlike *Cephalogale,* all the species of which are, moreover, much smaller. Cooper pointed out that the absence of M^3 prohibits a reference to *Amphicyon*. Since, however, the Amphicyonine genera *Pliocyon* and *Pseudamphicyon* equally lack M^3, this character does not prevent its being Amphicyonine. It is even possible according to Matthew (1929, p. 481) that certain European species referred to *Amphicyon,* such as *A. giganteus* may belong to *Pliocyon.* The relatively small transverse diameter of M^1 and the small size of M^2 militate against its being closely allied to *Amphicyon* or *Pliocyon,* though in both these characters *Pseudamphicyon* and *Vishnucyon* resemble it. A much closer affinity, however, seems to exist to the Pontian genera *Simocyon* and *Metarctos*. Of these *Metarctos* is much the more primitive on account of its full premolar dentition, probably present also in the Bugti species. The P^4 of *Metarctos diaphorus* from Montredon (*see* Pilgrim, 1931, p. 18) agrees nearly with that of the Bugti species in size, relative length and absence of a parastyle. The fragmentary nature of Cooper's specimen and the fact that it so considerably antedates the known species of *Metarctos* naturally throw doubt on the generic reference suggested, which is, therefore, quite provisional. The European forms, however, seem to have been Sarmatian migrants, so that the occurrence of an ancestral type in the Burdigalian of Asia is less strange than would appear at first sight.

Sub-family : *CANINÆ.*

Diagnosis.—Canidæ with relatively long face and relatively low skull; auditory bulla large, inflated, closely adjacent to the paroccipital process; mastoid process small, little prominent; molars less reduced than in the Lycaoninæ; carnassials reduced but not the anterior premolars, which have prominent accessory cusps; upper molars with a tendency to diminish the transverse diameter, but less so than in the Lycaoninæ; M^1 with distinct hypocone and strong postero-internal shelf or cingular ridge; M^2 progressively reduced; M^3 absent; P^4 with antero-posterior diameter equal to or less than, occasionally slightly greater than, that of the united M^1 and M^2, with somewhat reduced protocone; M_1 with fairly strong metaconid, talonid with hypoconid and entoconid both forming equally strong cusps; M_2 with or without paraconid, with talonid as in M_1 M_3 present; humerus without an entepicondylar foramen.

Remarks.—Matthew (1924, pp. 121-128) entirely disagrees with the sub-division into alopecoids and thooids proposed by Huxley (1880) and accepted by later writers, and places all the modern Canidæ into this sub-family, with the exception of the Lycaoninæ, which include *Lycaon, Icticyon* and *Cyon.* He finds that the two sub-families of the Caninæ and the Lycaoninæ are distinct from the Oligocene, while the Amphicyoninæ diverged still earlier. From the Oligocene upward the Caninæ are represented in North America by various genera, *Nothocyon, Tomarctus, Aelurodon,* etc. No member of the sub-family is known in Europe with certainty earlier than the Upper Pliocene, but from the Pontian of China the species *Canis antonii,* Zdansky (1924, p. 10), *Canis chihliensis,* Zdansky (1924, p. 13) and *Vulpes sinensis,* Schlosser (1903, p. 24) have been recorded. No Canid which can be referred to the sub-family Caninæ, is known from the Dhok Pathan stage of India, nor is it until the Upper Siwalik period, probably the Pinjor stage, that we meet with two undoubted representatives, *Canis cautleyi,* Bose and *Canis curvipalatus,* Bose, the latter of which seems to display certain *Otocyon*-like characters and may be on the ancestral line to that very aberrant South African form. In the present work I rank this as a distinct genus to which I give the name *Sivacyon.* All the evidence, therefore, points to the group having originated in North America and having spread to Asia much later.

Genus: CANIS, Linné.

Diagnosis.—Caninæ with skull heavy and deep; interorbital region thickened and elevated; postorbital processes thick, convex above, with rounded edges, situated behind the molars; nasals not excluded from contact with the maxillæ by any great extension of the frontal or premaxillary processes; profile of forehead rising rather abruptly above the level of the muzzle; teeth rather heavy and large; canines stout and not specially elongated, the tip of upper canine scarcely extending beyond the middle of mandibular ramus when jaws are closed; upper molars subtriangular with transverse diameter generally much in excess of antero-posterior diameter; M^2 much reduced; P^4 longer than M^1, without parastyle; M_1 with paraconid scarcely oblique to the longitudinal axis, talonid with a trenchant hypoconid and a small entoconid; M_2 occasionally with a vestigial paraconid, talonid as in M_1.

CANIS CAUTLEYI, Bose.

1868. *Enhydriodon sivalensis*, Falconer *pars*, Pal. Mem., I, p. 337.

1880. *Canis cautleyi*, Bose, *Quart. Journ. Geol. Soc. London*, XXXVI, p. 135, Pl. vi, figs. 7-9.

1884. *Canis cautleyi*, Bose, Lydekker, *Pal. Ind.*, (10), II, p. 259, text fig. 10, Pl. xxxii, figs. 3, 6.

Diagnosis.—A *Canis* of about the size of *C. pallipes* of India; M^1 with relatively large transverse diameter; front border concave; M^2 with transverse diameter proportionately less than in M^1; P^4 with antero-posterior diameter equal to or slightly greater than that of the united M^1 and M^2, protocone moderately well developed; M_1 with antero-posterior diameter equal to that of P^4 and relatively less than in most species of *Canis*; M_2 without paraconid or definite entoconid; M_3 small, with elongate oval outline.

Lectotype.—Matthew (1929, p. 487) has selected as the holotype of this species the mandibular ramus described and figured by Bose (1880, p. 135, Pl. vi, fig. 9), and by Lydekker (1884, Pl. xxxii, fig. 6). The specimen is in the British Museum registered no. 40181.

Paratype.—The mandibular ramus (Br. Mus. no. 40182) figured by Bose (1880, Pl. vi, figs. 7-8).

Referred specimens.—The associated skull and two fragments of the mandible from the Siwalik Hills preserved in the Science and Art Museum, Dublin (nos. 42*b* and 43). These were described and figured by Lydekker (1884, p. 259, text fig. 10).

The left maxilla collected by Col. Colvin from Dadupur, Siwalik Hills and preserved in Calcutta (G. S. I. no. D 35). This specimen is mentioned in Falconer's and Walker's Catalogue of the fossil Vertebrata in the Museum of the Asiatic Society of Bengal (1859, p. 189) and was described and figured by Lydekker (1884, p. 261, Pl. xxxii, fig. 3).

Locality.—The lectotype and paratype as well as the referred specimens came from the Siwalik Hills, but without any indication of the precise spot in which they were collected, except in the case of the maxilla (G. S. I. no. D 35), and even in this case it does not afford us definite information, since all the specimens of a rather large collection are similarly labelled.

Horizon.—It is highly probable that all the specimens belong to the Pinjor stage of the Upper Siwaliks.

Remarks.—All the specimens mentioned above have been described by Lydekker (1884, pp. 259-264). He considers that 'the Dublin mandible which is associated with a skull agrees precisely in every respect with the types and leaves no doubt that it belongs to the same species'. He also remarks with regard to the Calcutta maxilla that 'the teeth agree almost precisely with those of the Dublin cranium, the only distinction between the two being a slight difference in the form of M^2, which is probably only an individual variation'.

Lydekker (1884, p. 260) has called attention to certain differences between the Indian species and all existing wolves in respect of the angle, the condyle and the masseteric fossa. Matthew (1929, p. 487), however, remarks:—

'In fact the angular process is broken off in the fossil, and its apparent robustness is at least partly a result of unskilful preparation. The width and depth of the masseteric fossa is so much an individual and age character that it deserves no weight'.

The skull and upper dentition of this species probably afford more valuable evidence for separating it from other known species of wolf. The large transverse diameter of M^1 distinguishes it from most living forms, and from the Italian Pliocene species *C. falconeri*, Major, *C. etruscus*, Major, *C. olivanus*, Del Campana and *C. majori*, Del Campana, but not very appreciably so from the Pontian Chinese species *C. antonii* and *C. chihliensis*, Zdansky. On the other hand the transverse diameter of M^2 is relatively less than in *C. antonii*, *C. chihliensis* and *C. falconeri*, but agrees more nearly with M^2 of *C. lupus*, *C. pallipes* and other living wolves, and also with *C. etruscus*. The antero-posterior diameter of P^4 in *C. cautleyi* is equal to or very slightly exceeds that of the united M^1 and M^2, in which it is closer to *C. lupus* than to *C. pallipes*. *C. antonii* and *C. etruscus* agree with *C. lupus* and *C. cautleyi*. In *C. chihliensis*, *C. olivanus* and *C. majori* the former measurement is decidedly less, while in *C. falconeri* P^4 is still longer than the united M^1 and M^2. The antero-posterior diameter of M_1 is equal to that of P^4 in *C. cautleyi*. In *C. lupus* and most recent species it exceeds it in a greater or less degree. In addition to the points mentioned, *C. falconeri* is absolutely much larger than *C. cautleyi*, and *C. olivanus* and *C. majori* are much smaller. *C. falconeri* has moreover a larger protocone in P^4. *C. etruscus* agrees with it in size, but differs in the structure of its M_1, which has a larger talonid, and much more strongly developed hypoconid and entoconid, and also a larger metaconid. *C. chihliensis*, in addition to the differences mentioned above, has a more rectangular M^1 than in *C. cautleyi*, while M^2 is absolutely larger in every dimension. It appears that the nearest resemblances to *C. cautleyi* are to be found in the Pontian *C. antonii* so far as the material available for comparison enables me to judge. The Pontian species is slightly larger; M^1 has a convex anterior border instead of a concave one; its cusps are more conical; and the transverse diameter of M^2 relatively greater.

In conclusion it seems certain that *C. cautleyi* is entitled to specific distinction from other known species, whether living or fossil. I cannot, however, suggest any definite genetic affinity with one of the living species rather than another. Still less can I venture to derive it from one of the Pontian forms. The less reduced M^2 of the two Chinese species certainly indicates a more primitive condition, but the other features of difference cannot necessarily be referred to time mutation. Lydekker's (1884, p. 263) attempt to prove that *C. cautleyi* is more specialised than the existing species of wolves is far from convincing.

Genus: SIVACYON, nov.

Diagnosis.—Caninæ with very low, lightly built skull; short muzzle; low relatively broad occipital; condyles broad; paroccipital process more cylindrical and less extended over the auditory bulla than in many other genera; interorbital region flat; post-orbital processes thin, slightly concave above;

orbits small; dorsal profile rising very gradually and not to any great extent above the level of the muzzle; skull with a distinct sagittal area, behind which is a marked sagittal crest about 20 mm. long; palate diminishing but slightly in breadth from behind forward and somewhat extended behind the molars; upper molars with transverse much exceeding antero-posterior diameter; their outer borders almost parallel to the median line of the palate and only slightly inclined to the axis of P^4; M^1 with outline inclined to rectangular rather than triangular; M^2 only slightly reduced relative to M^1; outline subtriangular; metacone almost as large as paracone; M^3 absent or at least only vestigial; P^4 somewhat longer than M^1, more sectorial than in *Canis*, less so than in *Vulpes*; with protocone larger than in *Vulpes*; anterior premolars of small size but less compressed than in *Vulpes*; canine slender but less elongated than in *Vulpes*; mandibular rami bounding a U-shaped space; ramus with a subangular process; M_1 stouter than in *Vulpes*; with paraconid not oblique; metaconid almost on the same level as the protoconid; talonid long; with large entoconid and somewhat trenchant hypoconid; M_2 without paraconid; lower premolars elongate, crowded, with short post-canine diastema; M_3 small, oval.

Genotype.—Canis curvipalatus, Bose (1880, p. 134).

SIVACYON CURVIPALATUS (Bose).

(Plate I, fig. 6.)

1836. *Canis vulpes* (?) Baker and Durand, *Journ. As. Soc. Beng.*, V, p. 581, Pl. xxvii, figs. 9, 10.
1880. *Canis curvipalatus,* Bose, *Quart. Journ. Geol. Soc. London,* XXXVI. p. 134.
1884. *Canis curvipalatus,* Bose, Lydekker, *Pal. Ind.*, (10), II, p. 253, Pl. xxxii, figs. 1, 7.
1928. *Nothocyon curvipalatus* (Bose), Pohle, Die Raubtiere von Oldoway, Wiss. Ergeb. d. Oldoway-Exped. p. 50.

Diagnosis.—As the only species known, the diagnosis is that of the genus.

Holotype.—The associated skull and mandible briefly described and figured by Baker and Durand (1836, p. 581, Pl. xxvii, figs. 9, 10) under the name of *Canis vulpes* (?) and more fully described by Bose (1880, p. 134) as *Canis curvipalatus.* These are in the British Museum regd. no. 37149.

Locality.—The Siwalik Hills; between the Markanda Pass and Pinjor.

Horizon.—Upper Siwalik, probably Pinjor stage.

Remarks and comparisons.—The holotype has been fully described and figured by Lydekker (1884, p. 253, Pl. xxxii, figs. 1, 7). He called attention to several features in which it resembles or approaches the South African genus *Otocyon* and has remarked (p. 258) that 'in respect of the structure of the teeth, it is on the whole nearest to the lowest alopecoids' and that:—

> 'From the number of the cheek teeth it seems right to refer the fossil to the genus *Canis* (*Vulpes*); but there is no doubt that it tends in a very marked degree to bridge over the difference between that genus and *Otocyon.* The most probable interpretation of the genetic

affinity of *Canis curvipalatus* is that it is a form derived from the primitive ancestral stock of *Otocyon*, and that it is on the direct ancestral line of the existing small alopecoids, its resemblance being greater to the North American *C. littoralis* than to the Indian *C. bengalensis*.'

Lydekker here accepts Huxley's (1880, pp. 261, 264, 286) view that *Otocyon* is a primitive form, the presence of M^4 being a survival of the dentition of ancestors of the Canidæ and carnivorous Marsupials. Flower and Lydekker (1891, p. 555) observed that there is no palæontological proof of this. Winge (1895, p. 61) took a definitely contrary view to that of Huxley as to the primitive character of *Otocyon.* Carlsson (1905, p. 733) emphasised the affinities of *Canis curvipalatus* to *Otocyon* and regarded it as directly ancestral to the modern form, thus taking the view that all the peculiar characters of *Otocyon* are secondary developments, including the extra molars. Matthew (1924, p. 121) while admitting that 'palæontology gives no evidence as to the ancestry of *Otocyon*' considers that 'this genus is not so aberrant in other osteological features as one might expect; and probably represents not so much a stock of ancient differentiation from the rest of the Canidæ, as a peculiar aberrant adaptation based upon an abnormal mutation'. He notes that 'the type of *Amphicyon frendens* shows on one side a partly preformed M_4, probably a reduplicated M_3. Similar reduplication among modern Canidæ has been recorded several times'. Pohle (1928, p. 50) finds evidence in support of Carlsson's theory in the species *Prototocyon recki* from the Pleistocene of Oldoway, which represents an intermediate stage between *Canis curvipalatus* and *Otocyon*, and considers that the three forms are phylogenetically connected. He remarks of *C. curvipalatus* 'Dieser ist aber noch ein typischer Hund der in die Gattung *Nothocyon* gehört'. While not altogether agreeing with Pohle as to the generic attribution of *Canis curvipalatus*, his arguments seem to be sound. We should have to look very far back to find a Canid in which M^3 occurred normally except in the Amphicyoninæ, which are not only extremely large, but also differ considerably from *Otocyon* in other osteological features. If M^4 is a secondary development, why not also M^3?

Although the holotype is somewhat flattened by crushing, yet the dorsal profile, which rises but slightly above the horizontal; the small height at the frontals; and especially the low broad occipital must be in great part real. These features as well as the slighter build, the more sectorial teeth and the slenderer canines distinguish it markedly from the genus *Canis.* Though much closer to *Vulpes,* as Lydekker and Matthew (1929, p. 486) have indicated, yet the skull is still too low for that genus; the muzzle is shorter; the orbits are smaller; the tooth row is shorter; the palate diminishes less in width from behind forward and is extended behind the molars; the condyles are wider; the sagittal crest is stronger, and extends further forward; the sagittal area is more marked; P^4 is more stoutly built and has a larger protocone; the upper molars are less oblique to the longitudinal axis and have a considerably greater transverse diameter; M^2 is less reduced, and has a larger metacone; the mandibular rami enclose a U-shaped instead of a V-shaped space; the hinder part of the ramus is deeper and has a partial sub-angular process (shown in the figure of the left ramus in Pl. i, fig. 6 of the present work); M_1 has the metaconid on a level with, instead of behind the protoconid.

Although Pohle assigns the species to the genus *Nothocyon*, I cannot see that it possesses more than a few of the distinctive characters by which Wortman and Matthew diagnose either the genotype of *Nothocyon*, *N. geismarianus* or the other John Day species, *N. lemur* and *N. latidens* or even the South American species, *Canis urostictus* and *Canis parvidens*, which those authors provisionally refer to the genus *Nothocyon.* Matthew himself, who has studied the types of *C. curvipalatus* (1929, p. 485), has evidently seen no particularly close resemblances between it and *Nothocyon.* Both have small orbits, a short muzzle and P^4 is shorter than in *Vulpes*, being the same length as (in *C. curvipalatus* slightly longer than) M^1. The following differences are observable:—The height of skull is less in *C. curvipalatus* than in *Nothocyon*; the sagittal and lambdoidal crests are stronger in *C. curvipalatus* than in *Nothocyon*; the palate is narrower; the hinder part of the ramus is not as deep in *Nothocyon* as in *C. curvipalatus*, nor is there a sub-angular process; the upper molars of *Nothocyon* are subquadrate, instead of being extended transversely as in *C. curvipalatus*; the angle between the upper molars and P^4 is more open in *C. curvipalatus* than in *Nothocyon*; the premolars are still more reduced in *Nothocyon* than in *C. curvipalatus*; in M_1 of *C. curvipalatus* the metaconid stands almost on the same level as the protoconid instead of behind it and the talonid is longer than in *Nothocyon.*

Canis curvipalatus agrees with *Otocyon* as opposed to *Vulpes* in the reduction of P^4 and M_1 and of the anterior premolars, but the reduction has gone considerably farther in *Otocyon*, though the retention of a parastyle in the latter is rather curious. In the characters mentioned the Indian fossil is really closer to *Nothocyon* than either to *Vulpes* or *Otocyon*.

Certain peculiar features of *Otocyon* are, however, distinctly foreshadowed in *C. curvipalatus*, while *Nothocyon* has little or no trace of them. These are:—a narrow palate which is almost the same breadth from end to end; the extension of the palate behind M^2 (in *Otocyon* it is extended far behind M^3); the low rather broad cranium; the prominent lambdoidal crest; a marked sagittal area (in *Otocyon* it is still broader and the sagittal crest is much diminished behind it); the upper molars are almost parallel to the median line of the palate in *C. curvipalatus*, while P^4 is but slightly oblique to it (in *Otocyon* both the upper molars and P^4 form practically a straight line, which is quite parallel to the median axis); the mandibular rami enclose a U-shaped space; in M_1 the talonid is as long as the trigonid and the metaconid is almost on a level with the protoconid; (in *Otocyon* the trigonid is still more reduced and the paraconid is much more oblique to the axis of the tooth); the hinder part of the mandibular ramus is deep and there is a subangular process, much more marked in *Otocyon* than in *C. curvipalatus* (a similar one exists in *Canis virginianus*). Beyond the characters mentioned the most striking features of *Otocyon* which seem to imply a high degree of specialisation are the presence of M^3 and the extraordinarily reduced P^4 and M_1.

Pohle (1928, p. 50) has pointed out that the Pleistocene species *Prototocyon recki*, though rather closer to *Otocyon* occupies an intermediate position between it and *C. curvipalatus*. He remarks 'Diese Merkmale, in denen sich *Prototocyon* bald wie *Otocyon*, bald wie *C. curvipalatus* verhält, bald eine Zwischenstellung einnimmt, liessen sich beliebig vermehren'. The skull of *Prototocyon* is higher; the sagittal area broader; the sagittal crest shorter; the reduction of P^4 greater; the palate is slightly more extended behind M^2 (M^3 being absent as in *C. curvipalatus*). Both the Indian and the African fossil species have a rather broader muzzle than in *Otocyon*, and have the temporal ridges which bound the sagittal area less prominent. They also agree in having a shorter, lower and less inflated bulla than in *Otocyon*, with a correspondingly taller parocipital process, which is more distinctly separate from the bulla.

In conclusion I may say that Pohle's view that the three species form a genetic group seems to be justified, but in the circumstances, it appears better that the Indian fossil species should be distinguished by a generic name of its own, and for this I propose that of *Sivacyon*.

Family: *URSIDÆ*.

Diagnosis.—Arctoidea with broad muzzle; short premaxillæ; wide palate; auditory bulla moderately prominent in the Cynodontinæ, in other subfamilies depressed (from palatal view) almost or quite into the plane of the basi-occipital, with long meatal tube; carotid canal behind the bulla close to the foramen lacerum posterius; mastoid and paroccipital processes strongly developed; alisphenoid canal present except in *Ailuropoda*; basi-occipital wide; dental formula $\frac{3\cdot1\cdot4\text{-}1\text{-}2}{3\cdot1\cdot4\text{-}1\text{-}3}$; anterior premolars small, occasionally reduced in number; P^4 in the most primitive genera situated behind the infra-orbital foramen, longer than M^1 and sectorial, but progressively pushed forward in front of the infra-orbital foramen, shortening and becoming bunodont; protocone long, progressively shifted to the rear of the crown; M^1 primitively slightly broader than long and shorter than P^4, progressively lengthening relative to its breadth and to the length of P^4, more or less clearly 4-cusped; M^2 oval or square in the most primitive genera, progressively lengthening relatively to its breadth; M^3 absent; M_1 long and sectorial in the most primitive genera, progressively shortening and becoming bunodont; talonid basin-shaped, except in *Dinocyon* and *Cephalogale*; M_2 in primitive genera much shorter than M_1, progressively lengthening; M_3 circular in primitive genera, progressively lengthening; humerus with or without an entepicondylar foramen; extremities short and broad; plantigrade except in *Cephalogale* and *Hemicyon*; digits five on both manus and pes; fifth digit often stronger than the others.

Remarks.—The genera which I include in this family are those placed in it by Schlosser (Zittel, Grundzuge der Palaontologie, 1923, p. 470) with the addition of the genera which comprise that author's Cynodontinæ as a subfamily of the Canidæ (1923, p. 469).

Sub-family : *HEMICYONINÆ.*

Diagnosis.—Ursidæ with profile of face and occiput almost rectilinear; oblique orbits; infra-orbital foramina rather remote from the orbits; temporal fossae long and deep; palate not extending behind the teeth; occiput low; sagittal and lambdoidal crests prominent; zygomatic arches only moderately wide; P^4 situated behind the infra-orbital foramen, antero-posterior diameter equal to or slightly exceeding that of M^1; protocone approximately median; cups sectorial; M^1 antero-posterior diameter slightly less than, to considerably exceeding transverse diameter, inner cusps forming a single or double moderate or strong wedge-like ridge but without intermediate cusps; M^2 heel absent or well developed; mandible often with premasseteric fossa (not present in *Indarctos*); M_1 sectorial; protoconid median to anteromedian; metaconid with a single cusp distinctly posterior to the protoconid; talonid broad; seldom with intermediate cusps between the trigonid and the talonid; M_2 antero-posterior diameter less than that of M_1, talonid relatively short and narrowed posteriorly; M_3 generally circular and one-rooted, occasionally slightly elongate and two-rooted; humerus with an entepicondylar foramen.

Remarks.—Frick's (1926, pp. 12-17) classification of the five genera *Dinocyon, Hemicyon, Ursavus, Indarctos* and *Agriotherium* (=*Hyaenarctos* auctorum) as a group, Hemicyoninæ, seems to have much in its favour. Frick apparently leaves this group in an intermediate position between the Canidæ and the Ursidæ and, in any case, emphasises the entire absence of genetic affinity between *Ursavus* and *Ursus* and between *Agriotherium* and *Arctotherium.* His arguments (Frick 1926, pp. 9, 95, 111-113) against such an ancestry seem to me rather inadequate, while there is even more to be said in favour of a descent of *Arctotherium* from either *Indarctos* or *Agriotherium.* I have discussed the question somewhat more fully elsewhere (Pilgrim 1931, pp. 20-21, 29, 33).

Genus : AGRIOTHERIUM, Wagner.

1836. *Ursus pars*, Falconer and Cautley, *As. Res.* XIX, p. 193.

1837. *Agriotherium* Wagner, *Gelehrte Anzeigen bayer. Akad. Wiss. Munich*, V, p. 335.

1841. *Amphiarctos*, Blainville, Ostéographie, fasc. 9, p. 96.

1841. *Sivalarctos*, Blainville, *Ibid.*, pp. 113, 114.

1845. *Hyaenarctos*, Owen (*ex* Falconer and Cautley MS), Odontography, pt. 3, pp. 504-5, Pl. cxxxi.

1868. *Ursus* (*Hyaenarctos*), Falconer, Pal. Mem. I, p. 321, Pl. xxvi, figs. 1-4.

Diagnosis.—Hemicyoninæ with base of zygomatic arch posterior to M^1; with premolars reduced both in size and number; upper molars with antero-posterior less than transverse diameter, with inner border shorter than outer border, with inner corners square or rounded; outer cusps blunter than in *Hemicyon*; M^2 without talon; P^4 with antero-posterior diameter greater than that of M^1, prominent parastyle; P^{1-3} single-rooted; mandible deep; lower molars narrow or broad; M_1 relatively short; with talonid much shorter than trigonid; entoconid low; hypoconid higher than entoconid; M_2 with talonid as in M_1; M_3 round to elongate; one lower premolar missing; anterior premolars single-rooted.

Genotype.—*Ursus sivalensis*, Falconer and Cautley (1836, p. 193).

Nomenclature.—The complete synonymy of this genus has been given by Lydekker (1884, p. 219). It appears that every author from Gervais (Zool. et Pal. francaises, 2nd ed., p. 208) onward has deliberately adopted *Hyaenarctos* for it to the exclusion of Wagner's prior name *Agriotherium.* At the present day when every endeavour is being made to stereotype for purposes of nomenclature that name which, while being valid, antedates all others that have been used, the only argument which can be considered to excuse the application of this principle is that change would cause confusion. In that case the name generally used but not the first suggested is stereotyped by special decree of the International Zoological Committee as a *nomen conservandum.* Since in the present case no confusion can result and the name *Hyaenarctos* will merely drop out of use it does not seem possible to disregard Wagner's name *Agriotherium* any longer.

Species.—Following Frick (1926, p. 64) the only species definitely assignable to this genus are those of which the upper dentition is known, since having regard to the fact that the mandible referred to *Agriotherium sivalense* was not associated with the type skull, the lower dentition alone, at any rate in the absence of the premolar series, does not enable us with certainty to distinguish between the two genera *Agriotherium* and *Indarctos.* Consequently in addition to the genotype only the following species can be assigned to *Agriotherium* :—*A.* sp., Gervais (1853, p. 152) from Alcoy; *A. insigne*, Gervais (1853, p. 152) from Montpellier; *A.* sp., Flower (1877, p. 534) from the Red Crag; *A. palaeindicum*, Lydekker (1878, p. 103) from the Dhok Pathan stage of India; *A. gregori*, Frick (1921, p. 342) from Eden, California; *A. schneideri*, Sellards, referred M^1 (Frick, 1926, p. 75).

Remarks.—Frick separates the species *A. palaeindicum* as a subgenus of *Agriotherium* under the name of *Lydekkerion*, but as pointed out below (page 41), there does not seem any particular reason to adopt this procedure. On the contrary Frick's refusal to grant to *Indarctos* separate generic rank from *Agriotherium* strikes me as rather illogical. The characters in which *A. palaeindicum*, Lydekker differs from other species of *Agriotherium* seem to be too trifling to possess more than specific value, and all the more so if, as I believe, the attribution of the two mandibles which Lydekker (1884, pp. 229, 234) referred to *A. punjabiense* and *A. palaeindicum* respectively is just the reverse of the one suggested by Lydekker. The Pontian *A. palaeindicum* may easily have been ancestral to one of the other species of *Agriotherium*, which are all post-Pontian. In any case Frick's subgenus *Lydekkerion* hardly rests on a sure foundation.

AGRIOTHERIUM SIVALENSE, Falconer and Cautley.

1836. *Ursus sivalensis*, Falconer and Cautley, *As. Res.* XIX, p. 193.

1837. *Agriotherium sivalense*, Wagner, *Gelehrte Anzeigen bayer. Akad. Wiss. Munich*, V, p. 335.

1841. *Amphiarctos sivalensis*, Blainville, Ostéographie, fasc. 9, p. 96.

1841. *Sivalarctos sivalensis*, Blainville, *Ibid.*, pp. 113, 114.

1845. *Hyaenarctos sivalensis*, Owen *ex* Falc. and Caut. MS, Odontography, pt. 3, pp. 504, 505, Pl. cxxxi.

1868. *Ursus* (*Hyaenarctos*) *sivalensis*, Falconer, Pal. Mem. I, p. 321, Pl. xxvi, figs. 1-4.

Diagnosis.—An *Agriotherium* intermediate between *A. gregori* and *A. insigne* as to size, general massiveness of the cusps, and strength of the parastyle of P^4; inner cingulum of molars stronger than in either of these species, outer border of P^4 between the paracone and the metacone indented; M^1 less wide transversely than in *A. gregori* and wider than in *A. insigne* and *A.* sp., Flower; inner corners of M^1 more rounded than in *A.* sp., Flower; inner ridge of M^1 less extended lingually than in *A. gregori* and *A. schneideri* referred, and more extended than in *A.* sp., Flower.

Holotype.—The skull described by Falconer and Cautley (1836, p. 193) and figured by Owen (1845, Pl. cxxxi); by Falconer (1868, Pl. xxvi, figs. 1-2); by Lydekker (1884, Pl. xxx, fig. 5); and by Matthew (1929, p. 475). It is preserved in the British Museum regd. no. 39721.

Referred specimens.—A mandible from the Siwalik hills (Br. Mus. no. 39722) figured by Owen (1845, Pl. cxxxi) and by Falconer (1868, Pl. xxvi, figs. 3, 4) and described by Lydekker (1884, p. 223). A femur (Br. Mus. no. 39723) described and figured by Lydekker (1884, p. 224, Pl. xxix, fig. 1); a radius and ulna (Br. Mus. nos. 39725-6); a metacarpal and phalangeal Br. Mus. no. 37147; an axis vertebra (Br. Mus. no. 37143). These were shortly described by Lydekker (1884, p. 225) and figured in unpublished plate 0 of the Fauna Antiqua Sivalensis. Finally a complete right ulna from Kasamuri *nala*, Saharanpur in the Siwalik Hills was figured and described by Lydekker (1888, p. 145). This last specimen was registered in the Geol. Surv. India collection, but has been mislaid, so that I have been unable to examine it.

Locality.—The holotype and the referred specimens were obtained from the Siwalik Hills, without any more precise locality being indicated, except in the case of the ulna last mentioned.

Horizon.—Matthew (1929, p. 475) has suggested that, since the other specimens of *Agriotherium* occur in the Dhok Pathan stage of the Middle Siwaliks, this species is more likely to belong to an older stage of the Upper Siwaliks (*i.e.*, Tatrot). This question of the possibility that certain Salt Range Tatrot species or nearly allied species were collected from localities of the same age in the Siwalik Hills is discussed above (pages 2-3). Since the species has not been rediscovered the suggestion lacks proof and since the genus occurs in the Red Crag deposits, it is at any rate just as likely that *A. sivalense* belongs to the Pinjor stage of the Upper Siwaliks.

Remarks.—The structure of all the known *Agriotherium* teeth varies to such a slight extent that it is probable that the differences noted by Frick (1926, pp. 71-75) are amply sufficient to justify the separation of the seven species of *Agriotherium* listed above (p. 38). The diagnosis above aims at presenting these differences as briefly as possible.

The holotype of *A. sivalense* has been described by Falconer (1836, p. 193) and Lydekker (1884, p. 220). Matthew (1929, p. 475) has made some illuminating observations on the resemblances and differences between it and the genera *Arctotherium* and *Pararctotherium,* which indicate the likelihood that a genetic relationship exists between these forms, contrary to the view advocated by Frick (1926, pp. 9,18). In particular Matthew points out that Lydekker's interpretation of the upper premolar series of *A. sivalense* is probably wrong on the analogy of *Arctotherium* and *Pararctotherium,* the three alveoli representing three single-rooted teeth so that P^1 is present. Matthew considers that the elongation of the alveoli in question suggests that the ancestor of *A. sivalense* possessed two-rooted upper premolars, a condition which exists in the earlier genus *Indarctos.* Dames (1883, p. 134), Schlosser (1888, p. 86) and Zdansky (1924, p. 18) also arrived at the conclusion that *Agriotherium* possessed a P^1, though the latter's suggestion that P^3 was two-rooted has been shown by Matthew (1929, p. 476) to rest on his mistaken assumption that a faint depression in the palate of the holotype shown in Lydekker's figure represented the alveolus for the front root of P^3.

Matthew (1929, pp. 475, 478), while recognizing the provisional reference of the mandible, evidently inclines to the opinion that the teeth are uncrushed and therefore narrower than in the genus *Indarctos,* in which I agree with him.

Lydekker (1884, p. 224 ; 1888, p. 145) has referred specimens of the femur and of the radius and ulna from the Upper Siwaliks of the Siwalik Hills to this species, on account of their great size, ursoid character and locality. The radius and ulna are of a slenderer type nearer to *Hemicyon* (Frick, 1926, p. 43) than is the case with the corresponding bones of *Indarctos oregonensis* (Merriam, 1916, p. 98) and of a species of *Indarctos* from Pikermi (Pilgrim, 1931, pp. 23-29), and therefore more remote from *Arctotherium* and *Ursus.*

From a general consideration both of the skull and dentition as well as of the skeleton, it seems likely that Matthew (1929, p. 480) is right in regarding the Arctotheriinae as derived rather from *Indarctos* than from *Agriotherium.*

AGRIOTHERIUM PALAEINDICUM, Lydekker.

1877. *Hyaenarctos sivalensis,* Falc. and Caut., Lydekker, *Rec. Geol. Surv. Ind.,* X, p. 33.
1878. *Hyaenarctos palaeindicus,* Lydekker, *Op. cit.,* XI, p. 103.
1884. *Hyaenarctos palaeindicus,* Lydekker, *Pal. Ind.,* (10), II, p. 232, Pl. xxx, fig. 1.
1884. *?Hyaenarctos punjabiensis,* Lydekker, *pars, Ibid.,* p. 229, Pl. xxxi, fig. 1.
1926. *Lydekkerion (H.) palaeindicus* (Lydekker), Frick, *Bull. Amer. Mus. Nat. Hist.,* LVI, p. 79.
1929. *Hyaenarctos palaeindicus,* Lydekker, Matthew, *Ibid.,* p. 476, text fig. 15.

Diagnosis.—An *Agriotherium* with cusps of upper molars, especially the inner ones, very prominent; M^1 with inner corners very rounded; M^2 narrowed posteriorly, with reduced metacone, outer cusps very oblique to the longitudinal axis, posterior corners obliquely truncated; P^4 rather shorter than in *A. sivalense,* with paracone proportionately less developed than metacone;

protocone stronger, connected with the prominent parastyle by a straight border, not with a re-entrant angle as in *A. sivalense.*

If the mandible is correctly referred; with ramus longer and shallower and with broader teeth than in *A. sivalense;* with P_2 missing and with a very long interval between P_1 and P_3; P_3 single-rooted.

Holotype.—The right maxilla with P^4-M^2 (Geol. Surv. Ind. no. D 16) described and figured by Lydekker (1884, p. 232, Pl. xxx, fig. 1).

Referred specimen.—The mandible (G. S. I. no. D 8) described and figured by Lydekker (1884, p. 229, Pl. xxxi, fig. 1) under the name of *Hyaenarctos punjabiensis.* This reference is discussed on page 46.

Locality.—The holotype came from an unknown locality, probably in the Salt Range area. The referred mandible was collected at Hasnot in the Salt Range.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Remarks.—Lydekker (1884, p. 233) considered that this species was closer to *Hemicyon,* and so far more 'dog-like' than either of the other Siwalik species of *Hyaenarctos,* because of the rounded inner corners and small antero-posterior diameter of M^1 and the obliqueness of the external cusps of M^2. Matthew (1929, p. 477) admits 'an approach to *Dinocyon,* but not enough to cast doubt on the generic reference'. Frick (1926, p. 61) notes that:—

> 'the species differs from *Hemicyon* in the P^4 parastyle being unusually developed, the protocone being slightly less posterior, the lowness of the main cusps, the more rounded lingual angles of the upper molars, the cutting away of the postero-internal corner, the smaller transverse diameter, and the greater prominence of the inner ridges especially anteriorly.'

He has established for it a new sub-genus of *Agriotherium* to which he gave the name *Lydekkerion.*

It does not seem to me that the features of difference from *Hemicyon* enumerated by Frick differ very greatly from those present in *Agriotherium sivalense,* except that they represent a more primitive stage of evolution. The position of the base of the zygomatic arch is the same in both, while neither has developed a talon to M^2. *Indarctos,* on the contrary, at any rate as regards the characters mentioned, is still more advanced than either *A. palaeindicum* or *A. sivalense,* its less reduced premolar series alone indicating a smaller degree of departure from the primitive ancestral type. If, as seems possible, the mandible (D 8) is correctly referred to *A. palaeindicum* then the likeness to *A. sivalense* becomes still more marked and that to *Indarctos* more remote. At any rate even if the mandible (D 8) does not belong to the species *A. palaeindicum,* it must belong to a species, which is on the same line as but more primitive than *A. sivalense* in respect of the shallower ramus, and the greater space occupied by the premolar series, although the premolars themselves are equally reduced in number and size, in both the Upper Siwalik and the Middle Siwalik mandible. If the species *A. palaeindicum* is separated sub-generically from *A. sivalense,* the sub-generic separation of *Indarctos punjabiensis* from *I. salmontanus* and the other species of *Indarctos* which are sufficiently well known to afford valuable characters for distinction seems logically to follow. I do not, however, think that either procedure is necessary; and this, so far as I can gather, is substantially the view held by Matthew (1929, pp. 474-478), who makes no mention of the sub-genus *Lydekkerion*.

Genus: INDARCTOS, Pilgrim.

1913. *Indarctos*, Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, pp. 281, 290.

Diagnosis.—Hemicyoninae with base of zygomatic arch opposite M^1 and the anterior part of M^2; premolars not reduced in number and less reduced in size than in *Agriotherium*; upper molars with antero-posterior greater than, occasionally only equal to, transverse diameter; inner border approximately square, but equal in length to outer border; M^2 with more or less developed talon; P^4 with antero-posterior diameter equal to that of M^1, parastyle reduced; P^2 and P^3 double-rooted; mandible generally shallower than in *Agriotherium*; M_1 relatively long, with talonid somewhat shorter than trigonid; high entoconid; hypoconid lower than entoconid; M_2 with talonid as in M_1; M_3 round to elongate; P_2 and P_3 double-rooted.

Genotype.—*Indarctos, salmontanus* Pilgrim (1913, pp. 281, 290).

Species.—As in the case of *Agriotherium* the position of those species which are only known by the lower dentition is open to doubt. We may with certainty assign to this genus: *I. oregonensis* Merriam, Stock and Moody (1916, p. 87); *I. lagrelii* Zdansky (1924, p. 16); *I. arctoides* Depéret (1895, p. 433; 1928, p. 149); *I. punjabiensis* Lydekker (1885, p. 226); an undescribed species from Samos in course of study by Dr. Helbing (*see* Pilgrim, 1931, p. 22). Species of which the mandible so closely resembles that of definite species of *Indarctos* that they may with great probability be assigned to this genus are: *I. sinensis*, Zdansky (1924, p. 24); *I. atticus*, Weithofer (*ex* Dames MS 1888, p. 231); *I. maraghanus*, Mecquenem (1925, p. 135); *I. ponticus*, Kormos (1913, p. 576).

Remarks.—Frick (1926, pp. 17, 61) regarded *Indarctos* as merely a sub-genus of *Agriotherium*, while at the same time he erected another sub-genus, *Lydekkerion* for the species *A. palaeindicum*. This view does not seem to have met with general acceptance. *Indarctos* has been accorded generic rank by Zdansky (1924, p. 16); Depéret (1928, p. 154); and Matthew (1929, p. 478). The most important characters in which *Agriotherium* differs from *Indarctos* are:—

(1) the base of the zygomatic arch is posterior to M^1;
(2) P^2 and P^3 and P_2 and P_3 are small single-rooted teeth; one lower premolar is missing;
(3) the upper molars have the inner border shorter than the outer border;
(4) M^2 has no talon;
(5) P^4 has the antero-posterior diameter greater than that of M^1, parastyle prominent;
(6) M_1 is relatively short with talonid much shorter than trigonid, and hypoconid higher than entoconid.

These differences seem to me to entitle *Indarctos* to generic distinction as much as *Ursavus*, though the species *I. punjabiensis* seems to some extent to bridge over the gulf between *Indarctos* and *Agriotherium*. *Indarctos* appears to represent a distinct line of development from *Agriotherium*, in some ways more and in others less advanced than the latter.

INDARCTOS SALMONTANUS, Pilgrim.

(Pl. III, fig. 9.)

1913. *Indarctos salmontanus*, Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, pp. 281, 290.
1914. *Indarctos salmontanus*, Pilgrim, *Op. cit.*, XLIV, p. 225, Pl. xx, figs. 1-3.

Diagnosis.—An *Indarctos* of larger size than *I. arctoides* and *I. lagrelii*; with broader and shorter talon to M^2 than in those species, but longer than in *I. punjabiensis;* hypocone of M^2 stronger than in *I. oregonensis* and talon slightly shorter; M_2 (referred) with much shorter talonid than in *I. sinensis.*

Holotype.—The left maxilla with M^2 and the broken crown of M^1 (Geol. Surv. Ind. regd. no. D 158) described and figured by Pilgrim (1914, p. 225, Pl. xx, figs. 1-3).

Referred specimen.—A left mandibular ramus (Geol. Surv. Ind. regd. no. D 159) figured in Pl. iii, fig. 9 of the present work.

Locality.—The type locality is Hasnot, Salt Range. The referred mandible came from the same locality.

Horizon.—The holotype almost certainly belongs to the Dhok Pathan stage of the Middle Siwaliks. The referred mandible also came from that level.

Remarks.—The holotype has been fully described (Pilgrim, 1914, p. 225). Its imperfect condition renders comparison with other species of *Indarctos* often difficult. Matthew (1929, p. 479), however, seems to have gone out of his way to try to prove that this species is a synonym of *I. punjabiensis.* To begin with his suggestion that the holotype of *I. punjabiensis* actually belongs to the same individual as the holotype of *I. salmontanus*, is definitely negatived by the fact that M^1 of the former specimen possesses well-marked roots and therefore cannot fit on to the broken base of M^1 in the latter. In the second place contrary to Matthew's statement the relative proportions of M^1 in the two specimens do not agree exactly, the antero-posterior diameter being slightly greater in the case of *I. salmontanus* (*see* Pilgrim, 1914, p. 226), while M^2 does not exist in the holotype of *I. punjabiensis.* The dimensions of M^1 in the maxilla (Geol. Surv. Ind. no. D 12) referred by Lydekker (1884, p. 228, text fig. 6) to *I. punjabiensis* do, however, agree exactly with those of M^1 of the holotype of *I. punjabiensis* and M^2, the only tooth in the maxilla which Lydekker has figured, is markedly different from M^2 of *I. salmontanus* in its much shorter talon. If, therefore, the holotype of *I. salmontanus* is regarded as conspecific with that of *I. punjabiensis*, it is obligatory to erect a new species for the maxilla (Geol. Surv. Ind. no. D 12) on account of the short talon of M^2. This Matthew has not done. It seems, however, quite unnecessary that this alternative should be forced on us, more especially as a short talon in M^2 is precisely what would be expected in the case of a species in which M^1 is almost quadrate.

The difficulty of deciding with which upper dentition the various *Agriotherium* mandibles from India should be linked, in the absence of any evidence of association, has afforded scope for more than one alternative conjecture. I have suggested in two different papers (Pilgrim, 1913, p. 290 ; 1914, p. 232) that the mandible referred by Lydekker to *Hyaenarctos palaeindicus* (G. S. I. nos. D 9, D 10, Pl. xxxi, figs. 2, 3) and that referred by the same author to *Hyaenarctos punjabiensis* (G. S. I. no. D 8, Pl. xxxi, fig. 1) might as reasonably be referred to *Indarctos salmontanus.* I now think that the more probable attribution of these two mandibles is a transposition of that suggested by Lydekker (*see* page 46). More recently a badly preserved mandibular ramus (G. S. I. no. D 159) figured in Pl. iii, fig. 9 of the present work was collected at Hasnot, which differs from both of the other two and seems to have a greater claim to be referred to *I. salmontanus.* M_1 is as long as in D 8 but is narrower in front and more tapering; M_2 is also narrower than in D 8, particularly in its posterior portion, which has a more pointed outline. The depth of the ramus is about equal to that of D 8, in both cases being clearly much less than in *A. sivalense,* contrary to Frick's impression (1926, p. 91). In neither case is there a premasseteric fossa, which is so marked in *A. sivalense.* The ramus (nos. D 9 and D 10) is even shallower, shows a slight indication of a premasseteric fossa and has a shorter M_1, without any tendency to taper at the ends. M_2 has an equally square outline. The undescribed Samos skull and mandible (*see* page 42), which through Dr. Helbing's courtesy I was permitted to examine during a recent visit to Basel, shows much the same characters. Since its upper molars are extremely close to those of *Indarctos salmontanus,* it seems likely that D 159 is really the mandible of *I. salmontanus* and that the mandibles (D 9 and 10) and (D 8) are referable to *I. punjabiensis* and *Agriotherium palaeindicum* respectively. The ramus of D 159 is certainly deeper than in the case of *I. lagrelii* but the associated ramus of *Indarctos arctoides* Depéret (1928, p. 150, Pl. ix, fig. 4) is even deeper. The teeth are too much advanced in wear to afford any information regarding the cusps or the length of the talonid. The dimensions of the lower teeth are given below.

Matthew's attempt to show that the Chinese species *I. lagrelii* is more primitive than *I. salmontanus* is largely based on his assumption that the latter is synonymous with *I. punjabiensis.* Even were the upper premolars of *I. punjabiensis* as Matthew has represented them (1929, p. 478, fig. 16) which itself is pure assumption, it does not in the least follow that the premolars of *I. salmontanus* were not two-rooted and as large as in *I. lagrelii.* In this case again the Samos skull affords useful data for comparison.

Measurements of the mandible (G. S. I. no. D 159).

M_1 Ant. post. diam.	40·0 mm.
Trans. diam.	20·5 mm.
M_2 Ant. post. diam.	28·0 mm.
Trans. diam.	20·0 mm.
Depth of ramus beneath M_1	58·0 mm.

INDARCTOS PUNJABIENSIS (Lydekker).

1878. *Hyaenarctos sivalensis*, F. & C., Lydekker, *Rec. Geol. Surv. Ind.*, XI, p. 103.
1884. *Hyaenarctos punjabiensis*, Lydekker, *Pal. Ind.*, (10), II, p. 226, Pl. xxx, figs. 2, 3.
1884. ? *Hyaenarctos palaeindicus*, Lydekker, *pars*, *Ibid.*, 234, Pl. xxxi, figs. 2, 3.
1926. *Indarctos* (*H.*) *punjabiensis* (Lydekker), Frick, *Bull. Amer. Mus. Nat. Hist.*, LVI, p. 76.

Diagnosis.—An *Indarctos* in which the upper molars are more nearly quadrate than in most other species, while the talon of M^2 is much less developed. Assuming that the mandible is correctly referred, P_3 is two-rooted.

Holotype.—The associated P^4 and M^1 of both sides and a probably associated anterior premolar (G. S. I. no. D 6) described and figured by Lydekker (1884, p. 226, Pl. xxx, fig. 2) and preserved in the museum in Calcutta.

Referred specimens.—A left maxilla (G. S. I. no. D 12) containing P^4 and M^1 with damaged crowns and the perfect M^2, described by Lydekker (1884, p. 228). Only M^2 of this specimen has been figured (Lydekker, 1884, p. 228, text fig. 6). Two probably associated fragments of a mandible (G. S. I. nos. D 9 and D 10), containing the left P_4 and M_1 and the right M_2 described and figured by Lydekker (1884, p. 234, Pl. xxxi, figs. 2, 3) under the name of *Hyaenarctos palaeindicus.*

Locality.—The type locality is Hasnot. The referred maxilla was collected from an unknown locality, probably in the Salt Range. The referred mandible came from Jabi in the Salt Range.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Remarks.—The specimens mentioned above have been fully described by Lydekker. Pilgrim (1913, p. 289 ; 1914, pp. 227-228, 231-232) ; Zdansky (1924, pp. 18, 20, 24) ; Frick (1926, pp. 79, 91) and Matthew (1929, pp. 477-479) have commented on Lydekker's conclusions, and due regard is here paid to their suggestions.

The species *Indarctos punjabiensis* stands alone amongst the various species of the genus, of which M^2 is known, in the little prominent talon of that tooth. This fact, if anything, adds yet greater force to my original disinclination (Pilgrim, 1914 ,p. 227) to unite the species generically with *I. salmontanus.* Since, however, both Frick and Matthew regard the talon of M^2, small though it be, as an important classificatory feature, distinguishing *I. punjabiensis* from species like *A. palaeindicum* and *A. sivalense,* I have in deference to them adopted that view, and all the more readily if the mandible (nos. D 9 and D 10) really belongs to this species, as I have suggested above. Matthew's view that *I. salmontanus* is a synonym of *I. punjabiensis* has been discussed above (p. 43). I do not think that it can be seriously entertained.

The question as to the attribution of the three Hemicyonine mandibles which are now known from the Dhok Pathan stage of the Middle Siwaliks is one to which it is difficult to give a definite answer. We have, however, at our disposal more data than when Lydekker wrote his account of the genus, seeing that there are not only associated mandibles of *Indarctos lagrelii*, Zdansky from China and

Indarctos arctoides Depéret from Montredon, but also the undescribed skull and mandible from Samos mentioned above, also clearly shown to be an *Indarctos* by its M^2. I have already (1914, p. 232) stated that Lydekker's opinion that the mandible (G. S. I. no. D 8) figured in Pl. xxxi, fig. 1 belonged to the same individual as the holotype of *I. punjabiensis* is not borne out by the colour or stage of wear of the two specimens. It will, therefore, be better to disregard entirely the localities where they were collected and arrive at a conclusion solely on the characters of the mandibles themselves. The suggestion that the mandible (nos. D 9 and D 10) attributed by Lydekker to *Hyaenarctos palaeindicus* and figured in Pl. xxxi, figs. 2, 3, was that of *Indarctos salmontanus* was made by me as early as 1913 (p. 290) but withdrawn in 1914 (p. 228). Zdansky (1924, p. 24) opposed my original view on the ground that as compared with *I. lagrelii* the talonid of M_1 was too short as compared with the trigonid in D 10 to warrant the attribution of that specimen to a species so closely allied to *I. lagrelii* as *I. salmontanus.* Matthew (1929, p. 478) revived my original suggestion, and at the same time pointed out that the supposed absence of M_3 in D 9 was due to an accident of preservation. The latter opinion had been previously expressed by Frick (1926, p. 92), who, however, did not disturb Lydekker's attribution of the mandible to *H. palaeindicus.* I think that there can be little doubt that the shallowness of the ramus, the strong entoconid and much lower hypoconid of M_1, the two-rooted P_3 ally this mandible much more nearly to the genus *Indarctos* than to *Agriotherium.* I admit the truth of Zdansky's contention that the talonid of M_1 is shorter than in the species *I. lagrelii.* It is also shorter than in *I. arctoides,* but this character, though possibly making it much less likely that it should belong to *I. salmontanus,* does not militate against an attribution to *I. punjabiensis,* which manifestly more nearly approaches *Agriotherium* than the other known species of *Indarctos.* On the contrary the mandible D 8 which Lydekker referred to *Hyaenarctos punjabiensis* possesses the *Agriotherium* characters of a rather deeper ramus, an entoconid much weaker than the hypoconid in M_1, a one-rooted P_3 and the disappearance of P_2. Moreover the talonid of M_1 is even shorter than in D 10. This is, therefore, more appropriately assigned to the species *Agriotherium palaeindicum.*

Sub-family : *AILUROPODINÆ,* Pocock (1921).

Diagnosis.—Ursidæ with short, rounded skull ; profile of face and occiput convex ; sagittal crest very high ; basi-occipital narrow ; auditory bulla irregularly shaped, not inflated ; glenoid fossa much extended transversely ; postglenoid process extremely high, coalescing with the anterior part of the bulla ; mastoid process long and compressed antero-posteriorly ; paroccipital process long, united with the mastoid process by a low concave ridge ; external auditory meatus extremely wide with its floor abbreviated and falling far short of the mastoid process ; zygomatic arches arising approximately above the middle of M^1 : alisphenoid canal absent ; palate not extended behind the teeth; post-orbital processes absent; anterior nasal foramen facing entirely forward; mandible with strong horizontal ramus, deeper behind than in front; symphysis long; coronoid process high and hooked; angular process much reduced, inflected; condyle much extended laterally; anterior premolars reduced, posterior premolars molarised; P^1 small or absent; P_1 absent; P^2 small or well developed; P_2 with accessory cusps; P^3 and P^4 extremely large with excessive development of accessory cusps; P_3 and P_4 with well developed accessory cusps; P^4 longer than M^1 with strong parastyle and an additional accessory cusp internal to it; molars bunodont; M^1 transverse greater than antero-posterior diameter, with well developed intermediate cusps; M^2 longer than M^1, with well developed intermediate cusps; M_1 longer than M_2; metaconid strong, on the same level as protoconid; strong paraconid and parastylid; strong hypoconid and entoconid; M_2 with numerous accessory cusps; M^3 approximately round, with numerous cusps; humerus with an entepicondylar foramen; with a long radio-carpal sesamoid.

Remarks.—This sub-family includes the living genus *Ailuropoda,* Milne-Edwards, and the extinct genus *Aelureidopus,* Woodward from a cave at Mogok, Ruby Mines, Burma.

Pocock (1921) has summarised the various views which have from time to time been advanced as to the classification of *Ailuropoda.* This is here briefly repeated for convenience sake. Mivart (1885, p. 392) saw the strong resemblance between the teeth of *Ailuropoda* and those of *Ailurus* and united these genera into a single sub-family of the Procyonidæ. Flower (1883, Encyc. Brit. (9) XV, p. 441) on the contrary included *Ailuropoda* in the Ursidæ, and this position was retained by Flower and Lydekker (1891, p. 260). Winge (1895, p. 62) considered the probable homologies of the cusps of P^4 in these and allied genera and concluded that the antero-internal cusp in *Ailurus* corresponds to the postero-internal cusp in *Ailuropoda,* both representing the protocone of *Ursus* and the Hemicyoninæ; the postero-internal cusp of *Ailurus* is unrepresented in either *Ailuropoda, Ursus* or the Hemicyoninæ, while *Ailurus* has no cusp homologous to the antero-internal cusp of *Ailuropoda;* finally the strong parastyle of *Ailuropoda,* which is unrepresented in *Ursus* finds an equally strong homologue in certain Hemicyonine genera, *Ursavus, Agriotherium* and *Indarctos.* Lankester and Lydekker (1901, p. 161) suggested homologies for the cusps of P^4 entirely at variance with Winge's views and adduced several additional arguments for the inclusion of *Ailuropoda* with *Ailurus* in the Procyonidæ, thereby reverting to Mivart's classification, though without acknowledgment of his paper, of which they seem to have been unaware. Bardenfleth (1914, pp. 1-15) in reconsidering the question of the affinities of these genera adopted Winge's view that the resemblances between the genera *Ailurus* and *Ailuropoda* are purely adaptive and while leaving *Ailurus* in the Procyonidæ, reaffirmed Flower's opinion that *Ailuropoda* is an aberrant member of the Ursidæ. Pocock (1921, p. 419) is on the whole in accord with Bardenfleth's arguments, but is of the opinion that 'the inclusion of *Ailuropoda* in the family of the Ursidæ would disturb the homogeneity of that family which already has some half dozen well defined genera'. He, therefore, has erected separate families for *Ailurus*, the Ursinæ and *Ailuropoda.* Although Pocock has not commented on the extinct genera, I imagine he would find a similar objection in including *Hemicyon, Ursavus, Agriotherium* and *Indarctos* as well as the Arctotheriinæ within the Ursidæ. Weber (1904, p. 535; 1928. p. 329) includes in the family of the Ursidæ not only the various Ursine genera, but also *Ailuropoda, Arctotherium* (=*Arctodus*) and *Agriotherium* (=*Hyaenarctos*), without actually suggesting any further sub-division. In the circumstances I am inclined to advocate the separation of *Ailuropoda* and *Aelureidopus* as a sub-family of the Ursidæ of equal value with the Ursinæ, Arctotheriinæ and Hemicyoninæ.

Genus : AELUREIDOPUS, Woodward.

1915, *Aelureidopus*, Woodward, *Proc. Zool. Soc. London* (1915), p. 425.

Diagnosis.—Ailuropodinæ in which the muzzle is shorter and blunter than in *Ailuropoda;* the frontal profile steeper; mastoid process irregularly ridged instead of smooth; the foramen which in *Ailuropoda* pierces the inner wall of the lachrymal pit, situated behind the lachrymal pit; P^1 absent; P^2 small and single-rooted.

Genotype.—Aelureidopus baconi, Woodward (1915, p. 425, Pl. i).

AELUREIDOPUS BACONI, Woodward.

1915. *Aelureidopus baconi*, Woodward, *Proc. Zool. Soc. London* (1915), p. 425, Pl. i figs. 1*a-c*.

Diagnosis.—The diagnosis of this, the only known species, is that of the genus.

Holotype.—The skull described and figured by Woodward (1915, p. 425, Pl. i, figs. 1*a-c*). It is preserved in the British Museum regd. no. M 10971.

Locality.—A cave near Mogok, Ruby Mines, Upper Burma.

Horizon.—Probably late Pleistocene.

Remarks.—The holotype has been fully described and figured by Woodward, and there is nothing additional to be said about it. Woodward points out how extraordinarily close it is in most respects to the living *Ailuropoda melanoleucus* Milne-Edwards. He even contemplated the possibility of uniting it generically with *Ailuropoda.* It is evidently not directly ancestral to the living form, on account of the greater reduction of the two anterior premolars.

Sub-family : *URSINÆ.*

Diagnosis.—Ursidæ with upper profile of skull strongly convex; facial profile sometimes concave; orbits not oblique; infra-orbital foramina not remote from orbits; temporal fossae shallow or absent; palate extending behind the teeth; occiput low; sagittal crest low; lambdoidal crest fairly prominent; zygomatic arches moderately to extremely wide; P^4 situated in front of the infra-orbital foramen, antero-posterior diameter much less than that of M^1, cusps bunodont, protocone tending to be shifted posteriorly, parastyle absent; molar crowns rather flat and with more or less wrinkled enamel surface; M^1 antero-posterior diameter considerably exceeding transverse diameter, inner cusps weak, either separate or fused into a more or less continuous ridge; M^2 progressively lengthening in excess of M^1, heel present and tending to lengthen; mandible without premasseteric fossa; M_1 rather bunodont; protoconid antero-median; metaconid with a double cusp on a level with the protoconid; talonid narrow; hypoconid stronger than entoconid; often with intermediate cusps between the trigonid and the talonid; M_2 primitively shorter than M_1 but progressively lengthening; M_3 generally elongate and 2-rooted, occasionally circular and 1-rooted; humerus without an entepicondylar foramen.

Genus : HELARCTOS, Horsefield.

1825. *Helarctos*, Horsefield, *Zool. Jour.*, II, p. 221.

Diagnosis.—Ursinae of small to medium size; skull short, broad, especially between the mastoid and zygomatic processes; mastoid process much expanded laterally; muzzle short (in living forms as broad as long); nasals very short; mandible with deep, heavy symphysis; premolar series more or less crowded; individual premolars generally larger than in other Ursinae; canine with relatively large base; P^4 with small protocone; M^2 much less than one third longer than M^1, short talon, with surface flatter, rather oblique and almost devoid of the rugosity seen in many other genera; M^1 less elongate; M_3 shorter relatively to M_2 (in living forms almost circular); M_2 approximately equal in length to M_1; M_1 with talonid broader and shorter than in other Ursinae, accessory cusps in front of and behind the metaconid but slightly pronounced.

Genotype.—*Ursus malayanus*, Raffles (1822, *Trans. Linn. Soc.*, XIII, p. 254, living in Burma and the Malay Peninsula and Archipelago.

Species.—The following species are included in this genus: *Ursus malayanus* Raffles; *U. arvernensis*, Croizet and Jobert from Mont Perrier, of which a variety, *ruscinensis*, Depéret occurs at Rousillon; *U. etruscus*, Cuv. from Italy; *U. namadicus*, Falc. & Caut.; and *U. böckhi*, Schlosser from Baroth-Kapecz.

HELARCTOS NAMADICUS (Falconer and Cautley).

1868. *Ursus namadicus*, Falconer, Pal. Mem., I, p. 321 footnote, p. 552, Pl. xxvi, fig. 5.

1884. *Ursus namadicus*, Falc. and Caut., Lydekker, *Pal. Ind.*, (10), II, p. 216, Pl. xxviii, fig. 3.

1890. *Helarctos namadicus* (Falc. & Caut.), Depéret, Anim. Plioc. Rousillon, *Mem. Soc. Geol. France*, Paléontologie, Mem. 3, p. 38.

Diagnosis.—A *Helarctos* of considerably larger size than *H. malayanus*; muzzle probably longer and narrower; M^2 somewhat longer and relatively narrower; M^1 relatively broader with a strong internal cingulum; P^4 relatively slightly larger, with protocone situated slightly more to the rear; P^3 larger.

Holotype.—The right maxilla with P^3—M^2 mentioned and figured in Falconer's Palaeontological Memoirs (II, p. 552, Pl. xxvi, fig. 5) and described and refigured by Lydekker (1884, p. 216, Pl. xxviii, fig., 3). This is in the British Museum, regd. no. 39720.

Locality.—The Narbada alluvial plain between **Jubbulpore** (Jabalpur) and Harda.

Horizon.—The Narbada stage, probably Middle Pleistocene.

Remarks.—The holotype was complete, as described above, when it was figured by Falconer, but had lost P^3 when it came under Lydekker's notice. The missing tooth has not been found since. Lydekker's description is sufficiently detailed, and needs no amplification. He stated that its nearest affinities seemed to be with *Ursus malayanus,* and Depéret (1890, p. 38) definitely included this species with *Ursus malayanus* and *Ursus arvernensis* in the genus *Helarctos.* I remarked (Pilgrim, 1914, p. 233) that it seemed to resemble *U. arvernensis.* (Croizet and Jobert, 1827, livr. 7, Pl. i, figs. 3, 4) more closely than *U. malayanus.* The characters in which the European Pliocene and the Indian Pleistocene species agree with one another and differ from the living species are the following: (1) their larger size; (2) more slender muzzle; longer and narrower M^2; longer premolar series. The Indian fossil species differs from both the others in the slightly more posterior position of the protocone of P^4.

The following are the approximate dimensions of the breadth of the palate between the anterior ends of M^2 in the three species.

H. malayanus	*H. namadicus*	*H. arvernensis*
39·0 mm.	35 mm.	31 mm.

It is unsafe to predicate because in the recent species the premolar series, the muzzle and M^2 are shorter than in the two fossil species, that, therefore, a progressive reduction in each of these features has taken place in the line of *Helarctos.* On the contrary other facts militate against this supposition. The mutation of *H. arvernensis,* which Depéret (1890, p. 34) has described from the older stage of Rousillon; and to which he gave the name var. *ruscinensis,* shows a decrease in the length and slenderness of the mandible comparable to, but much less marked than, that which we observe in *H. malayanus.* Further, if as Schlosser (1899, pp. 101-103) suggested, and Depéret (1928, p. 158) more definitely advocated, the genus *Ursavus* is on the direct ancestral line to *Helarctos,* then the course of development has tended to produce a more elongate muzzle, with longer molars and smaller premolars, in other words more *Ursus*-like features. Seeing that *Helarctos malayanus* is on the whole less *Ursus*-like than the Pliocene and Pleistocene species *H. arvernensis* and *H. namadicus,* then we must assume that it is more primitive than they, so that the two latter represent a more progressive line, which has left no descendants.

Matthew (1929, p. 473) has remarked that the tibia, (Br. Mus. no. 39727) referred by Lydekker (1884, p. 218, Pl. xxix, figs. 3, 3*a*) to this species does not belong to a bear. It is probably Feline.

Genus: MELURSUS, Meyer.

1793. *Melursus,* Meyer, Uebers neu. Zool. Entdeckungen in Neuholland und Africa, p. 155.

1811. *Prochilus,* Illiger, Prodr., p. 109.

Diagnosis.—Ursinae of moderate to large size; with narrow, elongate skull; orbit rather elongate, having antero-posterior greater than vertical diameter;

post-orbital processes not prominent; palate broad, greatly extended behind the teeth, concave in its hinder part; premaxillary region long and sloping upward; I^1 absent; the three front premolars moderately separated from one another; M^2 either slightly or considerably longer than M^1, not extending behind the base of the zygomatic process.

Genotype.—Bradypus ursinus, Shaw and Nodder (1791, Naturalist's Miscellany, II, Pl. lviii).

MELURSUS URSINUS (Shaw and Nodder).

The distal end of a right humerus (G. S. I. no. F 226), obtained from the Billa Surgam Cave deposit in the Karnul district, was described and figured by Lydekker (1886, p. 33, Pl. vii, fig. 21). Its exact agreement with the corresponding portion of the humerus of the living species left in his mind no reasonable doubt as to its specific identity.

MELURSUS (?) THEOBALDI, Lydekker.

1884. *Ursus theobaldi,* Lydekker, *Pal., Ind.* (10), II, p. 211, Pl. xxviii, figs. 1, 2.

Diagnosis.—A *Melursus,* of large size, considerably exceeding that of *M. ursinus;* profile of occiput less convex than in *M. ursinus;* auditory bulla at a considerably lower level than the sphenoidal surface; occipital condyles somewhat narrower than in *M. ursinus;* zygomatic process of squamosal projecting much farther outward than in *M. ursinus,* with a correspondingly broader glenoid area; palate more concave both antero-posteriorly and transversely, and relatively narrower than in *M. ursinus;* M^2 much longer than M^1, narrowing considerably behind, still more forwardly situated than in *M. ursinus;* P^4 more elongate than in *M. ursinus,* with less prominent protocone.

Holotype.—The skull (G. S. I. no. D 17) described and figured by Lydekker (1884, p. 211, Pl. xxviii, figs. 1, 2) which is preserved in the museum in Calcutta.

Locality.—The precise locality is not recorded, but Theobald collected it in the Kangra district.

Horizon.—The character of the matrix, which is grey sandstone, indicates the extreme probability that it was derived from the typical Upper Siwaliks of Kangra and not from the older reddish beds. It is likely that it belongs to the Pinjor stage, since no Tatrot species have been collected in the Kangra district. Schlosser (Zittel 1923, p. 471) is thus mistaken in his statement that this is the oldest known *Ursus.* The earliest age which can be given to this species is Upper Pliocene, so that *Helarctos arvernensis,* var. *ruscinensis* Depéret (1890, pp. 34, 118) certainly antedates it, and also *H. böckhi* Schlosser (1899, p. 87).

Remarks.—The holotype skull has not been entirely cleared of the hard grey sandstone matrix, in which it was originally enclosed. It is fairly well preserved, except so far as concerns its dentition, of which the tooth crowns have been completely battered away, and are only known by the sections of the roots, which are sometimes obscure. Lydekker has fully described it and nothing need be added to his description beyond what has been emphasised in the diagnosis. The antero-posterior diameters of the alveoli of the teeth are as follows: P^4 18 mm.; M^1 27 mm.; M^2 22·5 mm.

Lydekker (1884, p. 215) sees in this species a direct ancestor of the living *M. ursinus*, which he regards as a degenerate descendant of the Upper Siwalik species, its aborted dentition and the correlated features of the zygoma and palate being in his opinion due to a recent change in its feeding habits. Matthew (1929, p. 472) does not consider that the evidence is sufficient to prove Lydekker's contention. In particular I am disposed to think that the conformation of the basicranial region and the cranial profile would rather indicate that *M. theobaldi* is a terminal member of a line of bears somewhat apart from that leading to *M. ursinus*. At the same time the generic reference may be allowed to stand provisionally in view of the characters which it undoubtedly shares in common with *M. ursinus* alone among the Ursinæ, though in so doing we tacitly admit Lydekker's hypothesis that the dentition of *M. ursinus* is degenerate.

Family : *PROCYONIDAE.*

Diagnosis.—Arctoidea with auditory bulla small, not depressed; carotid canal internal to the bulla, remote from the foramen lacerum posterius; paroccipital process absent, small or broadened, moderately remote from the bulla; alisphenoid canal absent, except in *Ailurus* and allied genera; dental formula $\frac{3.\ 1.\ 4\text{-}3.\ 2}{3.\ 1.\ 4\text{-}3.\ \mathbf{2}\,(3)}$; premolars not reduced, with a tendency towards molarisation, especially the upper premolars; P^4 primitively with shearing metacone and rather high cusps; metacone progressively reduced and cusps becoming bunodont; hypocone sometimes absent but with a tendency to become enlarged; M^1 in most genera approximately square, larger than P^4 (in the most primitive genera, subtriangular and equal to P^4); generally with four cusps; M^2 generally subtriangular with three main cusps; M_1 with cusps of trigonid short and crowded, except in the most primitive genera; talonid broad with two cusps; M_2 similar in structure to and either shorter or longer than M_1; M_3 only present in the primitive genus *Phlaocyon*; extremities relatively long; plantigrade; digits five on manus and pes; third digit the longest.

Genus : SIVANASUA, Pilgrim.

1916. ***Ailuravus***, Schlosser, *Abh. bayer. Akad. Wiss.*, XXVIII, Abh. 6, p. 25.

Non ***Ailuravus***, Rütimeyer, 1891, *Abh. Schweiz. Pal. Gesell.*, XVIII, p. 94.

1931. ***Sivanasua***, Pilgrim, Br. Mus. Cat. of the Pontian Carnivora of Europe, p. 34 footnote.

Diagnosis.—Procyonidae with teeth low-crowned, with sharp angulated cusps and rugose enamel; with two lower molars; M_2 slightly larger than M_1; trigonid short; talonid distinctly longer than the trigonid, cusps in both low but sharp, more or less connected by sharp ridges, which enclose a more or less concave area both in the trigonid and in the talonid; protoconid and metaconid subequal; anterior ridge of trigonid, which connects the protoconid and paraconid, straight or curved, lower than that joining the protoconid and metaconid; paraconid not always differentiated into a definite cusp; talonid as broad as or broader than the trigonid, its cusps lower than those of the trigonid; entoconid almost as large as the hypoconid but sharper and more isolated; hypoconulid present or absent; P_3 and P_4 entirely molariform, identical in general structure with the molars, except for a relatively broader talonid without a hypoconulid; trigonid narrower than in the molars; metaconid slightly shorter than the protoconid and almost abreast of it; paraconid not always differentiated into a distinct cusp. On the assumption that the tooth figured by Schlosser (1916, Pl. ii, fig. 30) is M^2 of *Sivanasua viverroides*, add to the above: M^2 triangular, anterior side the longest, transverse much exceeding antero-posterior diameter with three main cusps; protocone rather large; paracone three times as large as metacone; two external cingular cusps; cingulum present, external to the metacone and posterior to the protocone.

Genotype.—Ailuravus viverroides, Schlosser (1916, p. 25, Pl. ii, figs. 30, 31).

Since the generic name given to this species by Schlosser had been preoccupied by Rütimeyer in 1891, the name *Sivanasua* was proposed (Pilgrim 1931, p. 34 footnote) to replace it.

Species.—In addition to the genotype, which occurs only in a fissure in the Jurassic limestone of Attenfeld near Neuburg (Bavaria, Germany) and has been considered on account of the associated fauna as of Vindobonian age, two additional species from India are now referred to the same genus: *Sivanasua pala indica* n. sp. from the Chinji stage near Chinji (Salt Range) and *S. himalayensis* sp. nov. from the Nagri stage of Haritalyangar (Belaspur State, Simla Hills). Of these the former is regarded as Vindobonian while the latter is somewhat later, though earlier than the Pontian.

Affinities.—The close resemblance between the lower molars of *Sivanasua viverroides* and still more of *S. palaeindica* and those of the Central and South American living genus *Nasua*, united with the absence of a third molar seems to make it almost certain that *Sivanasua* is a Procyonid. In both cases the trigonid is short and the talonid long and broad; the cusps are connected by marked ridges which result in the formation of a central basin both in the trigonid and the talonid. In *Nasua*, however, both the cusps and the ridges are more rounded. A hypoconulid is occasionally present in *Nasua*, at any rate in M_2. In the living genus M_2 is sometimes slightly smaller and sometimes slightly larger than M^1, so that no distinction can be made on this account. *Nasua* always has a prominent paraconid in the molars, but although in *Sivanasua viverroides* this cusp is almost as strong, in *Sivanasua palæindica* there is no definite cusp for the paraconid. The only consistent differences between the lower molars of the two genera are their diminished height, the smooth enamel and the absence or feebleness of the external cingulum in *Nasua*. The complete molarisation of P_4 in *Sivanasua*, however, gives it an altogether different appearance from P_4 of *Nasua*. Its shape suggests an analogy with the Lemuridæ, but the absence of M_3 prohibits any idea of a possible relationship to that family.

It may be remarked that other members of the *Procyonidæ* exhibit in one or another feature an analogous complication or molarisation of P_4. Thus the genus *Potos* (=*Cercoleptes*) shows a very distinct trace of a metaconid, and the general shape of P_4 is very similar to that of the Indian fossil tooth. It is true that there is no very close likeness as a whole to *Sivanasua,* on account of the almost entire obliteration of the cusps in both the last premolar and the two molars of the American living genus, though the fact that in *Sivanasua* they are much less prominent than in *Nasua* may indicate some slight tendency in this direction. In *Procyon* there is quite a strong metaconid in P_4, but the tooth is much shorter than in *Nasua* or *Sivanasua;* the protoconid has been developed at the expense of the paraconid and the anterior ridge, so that there is virtually no trigonid; the talonid has been equally abbreviated and there is no distinct entoconid cusp. The much stronger cusps of the molars and the reduced size of M_2 distinguish *Procyon* from both *Nasua* and *Sivanasua.* In *Ailurus* there is a strong paraconid in P_4 but no metaconid. The cusps of the molars are as strong as in *Procyon,* but they are distinguished from those of that genus by the greater length of the trigonid, by the superiority in size of M_2 over M_1 and by the numerous accessory cusps in the talonid. Even in the P_4 of *Nasua* indications are not wanting of features homologous to those present in the Indian fossil P_4. The principal cusp in the case of *Nasua* has another cusp behind it; in *Nasua rufa* this lies internally to a large hollow area, in *Nasua narica* it lies externally to a similar area. In *Nasua rufa,* however, there is another minute cusp behind and external to the principal cusp. These facts suggest that the homologies of the cusps in these two species may not correspond with their respective size and that the larger cusp in *Nasua rufa* and the smaller one in *Nasua narica* may represent the hypoconid, and that the hinder basin may be entirely homologous to the talonid of the molars, and may equally correspond to that part of the tooth in P_4 of *Sivanasua palæindica.* In any case the equivalent of the anterior cusp (paraconid) is either absent or is represented by a minute cingular cusp.

Schlosser (1916, p. 29) considers that '*Ailuravus*' (=*Sivanasua*) is the actual ancestor of *Parailurus* of the supposed Pontian of Hungary and of the Pliocene of England (Boyd Dawkins 1888, p. 228; E. T. Newton 1890, p. 451; Schlosser 1899, p. 73), the latter being obviously an ally of the living genus *Ailurus* of the Eastern Himalayan region. Schlosser's view is that the lower premolars underwent a complication analogous to that of the molars at an early stage and that the subsequent history of the phylum would show a simplification. For my part I am inclined to doubt the sufficiency of the evidence which Schlosser has advanced in support of this theory. In the first place *Sivanasua* seems to me to be closer to *Nasua* than to *Ailurus* in regard to the lower molars. In the second place P_4 is actually simpler in *Parailurus* than in *Ailurus,* contrary to what would be expected. One might suppose that the fossil Procyonidæ of America would bear out Schlosser's theory, at any rate partially, but this is not so. *Nasua* has been found in the Pleistocene of South America, and the allied genera *Cyonasua; Amphinasua,* and *Pachynasua* in the Pliocene of Argentina. The latter three genera seem to agree with *Nasua* in the structure of P_4.

The North American genera, *Leptarctus* from the Procamelus zone (Pontian or rather earlier), and *Phlaocyon* from the upper part of the White River beds (Upper Oligocene) have been claimed as ancestral forms of the Procyonidæ

(Wortman 1894, p. 229; and Wortman and Matthew 1899, p. 131). The former has now been classified by Matthew (1924, p. 138) with the *Mustelidae* mainly on account of the absence of M^2, although he mentions various resemblances in the dentition to the modern *Procyonidae*. On the whole he regards it as a very advanced aberrant type occupying a somewhat intermediate position between the two subfamilies. In any case its lower premolars show no particular indication of molarisation. *Phlaocyon* shows certain indications of characters having an evolutionary trend in the direction of *Procyon*, but not in that of *Nasua*. P_4 has a much simpler structure than in the case of the Indian fossil species. The presence of M_3 in *Phlaocyon* clearly shows that it is a much more primitive form than *Sivanasua*, as in fact its age would render likely. On Schlosser's hypothesis we must suppose that an Upper Oligocene primitive, simple type of lower premolar has become extremely complicated by the Tortonian, and that when we reach the Pontian it has again been simplified. I know of no parallel case of such a rapid course of evolution as this would render obligatory.

I prefer to think that *Sivanasua* represents a terminal line of inadaptive evolution, in which the most striking feature is the molarisation of the lower premolars. It is incontestable that no living form in the family of the *Procyonidae* has anything like the total degree of complication in P_4 which is the case in *Sivanasua*; yet it is noticeable that each genus exhibits that complication in individual details, one genus showing one feature and one another but no single living genus possessing all of them. One is equally struck by the fact that where we know with certainty the Pleistocene or Pliocene ancestor of any modern form, we see no greater complication of P_4 than is the case in its living descendant. These facts point to the conclusion that such a form of premolar as we get in *Sivanasua* exemplifies a precocious development, similar to but on a larger scale than what has happened in every known living member of the Procyonidæ. Every order of mammals can supply one or more parallel instances of an evolution of this kind.

Whether the resemblance between the lower molars of *Sivanasua* and *Nasua* indicate any actual genetic affinity dating from the Lower Miocene or earlier can only be a subject of conjecture with the present fragmentary material. It is conceivable that these resemblances are of a convergent nature and that the relationship between the two genera is not a particularly close one. To infer from the facts before us that *Nasua* is of Asiatic rather than of American origin would involve, however, some most gratuitous assumptions, and still more so to extend that origin to include the whole family of the Procyonidae, as some authors have suggested. In Matthew's opinion *Phlaocyon* has many of the characters appropriate to a Procyonid ancestor and though future discoveries may cause us to modify this view, yet we need at present seek no further for another to fill that place. It is, however, possible that *Sivanasua* represents the descendant of an early migrant belonging to the *Nasua* phylum, and if we accept the American origin of the family we must suppose that another migrant of another phylum gave rise to the Eurasiatic *Ailurus* and *Parailurus*.

SIVANASUA PALÆINDICA, sp. nov.

(Pl. II, figs. 10, 11, 12.)

Diagnosis.—A *Sivanasua* of considerably smaller dimensions than *S. viverroides;* the trigonid of the lower molars shorter relatively to the talonid than in *S. viverroides;* the ridge connecting the protoconid and the paraconid curved, the paraconid much lower than the protoconid and not indicated by a definite cusp; hypoconulid in lower molars prominent; area between the cusps of the talonid markedly basin-shaped; P_4 relatively larger and rather more advanced in molarisation than in *S. viverroides;* trigonid differing in no respect from that of the molars; talonid longer, broader and more basin-shaped than in *S. viverroides;* both entoconid and hypoconid almost as high as the cusps of the trigonid; with a marked posterior ridge but without a posterior cingulum.

Holotype.—A portion of the right mandibular ramus of an immature animal with M_1 in position and P_4 and M_2 *in alveolo.* This is in the collection of the Geological Survey of India in Calcutta regd. no. D 224.

Referred specimen.—An isolated M_2 (right side), almost identical with the M_2 in the type ramus, except that it had just come into use in the mouth, occurred in the same locality and horizon and is now in the British Museum.

Locality.—Chinji, Salt Range.

Horizon.—Lower Siwaliks, Chinji stage.

Description.—The holotype is a portion of the right mandibular ramus of an immature individual containing three teeth of which only one, M_1 had erupted, the remaining two, P_4 and M_2 being *in alveolo.* They have been exposed by cutting away the bone of the jaw. A small portion of the jaw remains behind M_2, and as there is no trace of any tooth germ to be discerned in the bone one may assume that M_3 was absent.

M_1 is oblong in outline, hardly tapering at either end; with coarsely wrinkled enamel. It is broadest about two thirds of the total length from the anterior end. It consists of two lobes, a shorter anterior one (trigonid), and a posterior one (talonid); the latter is very distinctly longer than the former. The trigonid contains two low but rather sharp cusps connected by a transverse ridge, an outer one (protoconid) and an inner one (metaconid). A ridge descends on the front side from the summit of the protoconid and forms a kind of ledge along the anterior margin of the tooth. The paraconid, which theoretically occurs on the inner side of this ledge to form a triangle with the other two cusps, is not represented by any very definite cusp. This ridge does not run straight from the summit of the protoconid to the point where the paraconid should be, but describes an arc of about a quarter of a circle. The ridges of the trigonid and the cusps which they unite enclose a basin-shaped area, with only a narrow opening on the inner side. The area of this basin is somewhat contracted owing to the fact that a rather strong rib descends from the summit of the protoconid into the hollow. The talonid contains three cusps (hypoconid, entoconid and hypoconulid) more or less connected by ridges and enclosing a central hollow. The hypoconid and entoconid lie opposite to one another and the hypoconulid behind the other two but on the inner side of the tooth. There is a cingulum on the outer side of the tooth just at the point intermediate between the trigonid and the talonid but nowhere else.

M_2 is almost identical with M_1 except that it is a slightly larger tooth, while the talonid is rather longer in proportion to the trigonid.

P_4 is about the same size as M_2 and is constructed on precisely the same principle as the molars, so that in describing it, I shall for convenience sake make use of the same cusp nomenclature ; in fact one cannot doubt that the similar cusps are homologous. The differences from the molars are the following :—The trigonid is relatively narrower and the greatest width of the tooth is almost at the extreme posterior end, so that its outline is not oblong but tends to taper regularly towards the front. Correlated with this it is to be noticed that the metaconid lies closer to the protoconid, and the rib which descends from the protoconid into the basin of the trigonid is weaker. The basin itself is thus deeper, and more open internally; while at the same time it is circular in shape instead of being transversely elongated as in the molars. Since the metaconid is situated nearer to the outer margin than in the molars it follows that the ridge which leads down from it to form the inner margin of the talonid is oblique instead of being very nearly antero-posterior as in the molars. Again the ridge which joins the hypoconid to the protoconid after running obliquely inward, then bends outward and at the instant when it meets the protoconid-metaconid ridge is pursuing a course parallel to the antero-posterior axis of the tooth. The paraconid is as indiscernible as it is in the molars. The metaconid and protoconid are approximately abreast; the metaconid is slightly shorter than the protoconid. Of the cusps of the talonid, only the hypoconid is at all prominent, the entoconid being weak and the hypoconulid absent. A cingulum with a small cusp is situated in just the same position which it occupies in the molars, between the trigonid and the talonid on the outer side.

Comparisons.—Although the comparisons with *Nasua* instituted above (pp. 53, 54) apply to the genus as a whole, yet the resemblances mentioned are more striking in the case of this than of the other species. This, however, applies only to the lower molars. When the peculiar molarisation of P_4 is taken into consideration as well as the structure of the molars, the closest affinity is undoubtedly to be found with '*Ailuravus*' (=*Sivanasua*) *viverroides* Schlosser (1916, p. 25). I am much indebted to Dr. Schlosser for his courtesy in having casts of these types prepared for me, so that I am enabled to compare them carefully with the Indian fossil.

M_2, in *Sivanasua viverroides* is constructed on the same lines as in *Sivanasua palaeindica;* the cusps and connecting ridges are even sharper than in the Indian species, the enamel is coarsely wrinkled, and a more continuous external cingulum exists. The paraconid is, however, pronounced and is almost as high as the protoconid ; it also lies farther forward so that the ridge which joins it to the protoconid is perfectly straight, not curved as in *S. palaeindica;* thus it also comes about that the trigonid is longer relatively to the talonid than in either *Nasua* or *S. palaeindica;* the three cusps of the trigonid form an almost perfect equilateral triangle and since the slope of the area enclosed by them is regularly inward, it forms much less of a basin than in either the living genus or the fossil Indian species. The metaconid is larger than the protoconid. Similarly the talonid is much less hollowed than in the other two forms, and the hypoconulid lies more to the rear, so that the posterior end of M_2 is more pointed than in the Indian tooth.

P_4 of the genotype, displays an entirely analogous molarisation to that which we find in *Sivanasua palaeindica.* The trigonid shows the same three cusps which are present in the molars, but the protoconid and metaconid are closer together and the paraconid lies farther forward than is the case in the molars so that the trigonid is narrower and more elongated. The talonid on the contrary is extremely short, there is no hypoconulid, and the hypoconid and entoconid are in close juxtaposition to the trigonid cusps and much lower; there is a well marked posterior cingulum. It is thus evident that P_4 differs less in structure from the molars in the case of *Sivanasua palaeindica* than in that of *S. viverroides,* while the basin-shaped talonid of the Indian fossil more nearly resembles the hollow area at the rear of P_4 in *Nasua,* though whether the two respective hollows are homologous or not is uncertain.

The resemblances between the Indian teeth and those of *Sivanasua viverroides* are so pronounced that it seems hardly possible on the material at present available to refer them to another genus. The differences between the Chinji and the Neuburg species are on the whole such as might arise on the same line in a more advanced form, and it is indeed not unlikely that the horizon from which *S. palaeindica* came is at any rate slightly newer than that of the European form. Still more probable is this in the case of the species *S. himalayensis* which occurs at the base of the Middle Siwaliks. Additional material might well necessitate the generic separation of the Indian and European forms, but for the present it seems more useful to emphasise the affinities of the two forms, which are unique among the Mammalia, by provisionally including them in the same genus.

The measurements of the known teeth of the two species together with those of the corresponding one in *Nasua rufa* are tabulated below for purposes of comparison :—

	P_4			M_1		M_2		
—	*Sivanasua palaeindica.*	*Sivanasua viverroides.*	*Nasua rufa.*	*Sivanasua palaeindica.*	*Nasua rufa.*	*Sivanasua palaeindica.*	*Sivanasua viverroides.*	*Nasua rufa.*
Ant. post. diam.	7·2	8·6	8·5	6·7	8·0	7·5	12·2	8·0
Trans. diam.	4·9	5·5	4·6	4·9	5·6	5·1	7·2	5·6
Length of trigonid	3·5	6·1	..	3·0	3·9	3·4	6·0	2·8
Length of talonid	3·9	2·8	..	3·9	4·3	4·4	7·0	5·2

SIVANASUA HIMALAYENSIS, sp., nov.

(Pl. II, fig. 13.)

Diagnosis.—A *Sivanasua* of slightly larger size than *S. palaeindica*; with relatively broader, lower molars, without a hypoconulid.

Holotype.—A fragment of the right mandibular ramus containing one tooth (?M_1), and parts of the alveoli of the teeth immediately preceding and following it. It is in the collection of the Geological Survey of India in Calcutta regd. no. D 237.

Locality.—Near Haritalyangar (Belaspur State, Simla Hills).

Horizon.—The Nagri stage of the Middle Siwalik, or possibly slightly below this.

Description.—The holotype belonged to a fully adult animal, since the single tooth which it contains has the cusps and ridges somewhat worn. The beginnings of the alveoli of fairly large roots both in front of as well as behind this tooth are visible, from which it appears to be M_1. It is an oblong tooth, with coarsely wrinkled enamel and like the lower molars of *Sivanasua palaeindica* consists of a short trigonid of theoretically three cusps and a talonid approximately equal in size to the trigonid consisting of two high pointed cusps. I am unable to say whether the paraconid actually existed as a definite cusp, since a fracture has removed the inner end of the ridge where the paraconid should occur. There is a well marked external cingulum.

Remarks.—The resemblance of the tooth just described to the corresponding one of *Sivanasua palaeindica* is so close that its generic position is not in doubt. Its breadth exceeds that of the Chinji species both absolutely as well as relatively to the length. The absence of a hypoconulid not only makes the talonid shorter but gives the posterior end a square instead of a tapering outline.

The slight differences mentioned and the fact that it is rather more recent in age than *S. palaeindica* have caused me to venture to establish a third species of *Sivanasua*. The loss of the hypoconulid would seem to be quite in accord with *S. himalayensis* representing a more advanced stage in the evolution of the phylum, in so far as it shows an approximation to the recent genus *Nasua,* where the hypoconulid is also missing in M_1 and often in M_2 as well.

Family: *MUSTELIDAE.*

Diagnosis.—Arctoidea with auditory bulla inflated in the earliest members, later becoming flattened; paroccipital process broadened, not in contact with bulla; alisphenoid canal absent; dental formula $\frac{3.1.4.\ 2\text{-}1}{3.1.4.\ 2}$; P^4 with protocone long or short, strong paracone and shearing metacone; M^1 transversely broadened, often large and rectangular, generally with broad, well developed cingulum; M^2 if present very small, lost at an early stage; M_1 with well developed trenchant or basin-shaped talonid, the hypoconid being invariably the trenchant cusp; in most cases with metaconid; M_2 often 2-rooted but generally much reduced; digitigrade or semi-plantigrade; digits almost always five in both pes and manus.

Remarks.—It is probable that the genera included in the Mustelidæ do not form an altogether natural phylogenetic group, but are of heterogeneous origin. Still more would this be the case if like Schlosser (**1923**, p. **473**), Helbing (**1928**, pp. **45**, **64**) and some other authors the so-called Stenoplesictinæ (Teilhard) are classified as one of their sub-families. I state below (page 151) my reasons for distributing the various Stenoplesictine genera between the families of the Felidæ, the Viverridæ and the Mustelidæ, so that there remain only the genera which Abel, (Weber, **1928**, p. **333**) has divided into three sub-families: Mustelinæ, Melinæ and Lutrinæ. Following Pocock (1921, p. 834) I have separated *Mellivora* and its allies as a distinct sub-family, Mellivorinæ, from both *Gulo*, *Martes*, *Mustela* and the other genera included by Weber in the Mustelinæ. Pocock has split up the Mustelidæ still further into sub-families, but for practical purposes it seems better to adopt Weber's classification with the exception noted above.

Measurements of Indian Fossil Mustelidae (*Lower Dentition*).

	Breadth of ramus below M_1.	Depth of ramus below M_1.	M_2		M_1		P_4		P_3		P_2		P_1		C	
			a. p.	tr.	a. p.	tr.	a. p.	tr.	a. p.	tr.	a. p.	tr.	a. p.	tr.	a. p.	tr.
Promellivora punjabiensis (G. S. I. No. D 20).	10·1	18·3	..	..	..	6·0	8·4	6·2	6·1	4·2	5·3	..	3·5	..	11·6	8·5
Eomellivora (?) *tenebrarum* (G. S. I. No. D 22).	12·0	25·4	5·7	..	22·6	7·1	..	..	..	..	..	..	..	..	..	..
Eomellivora (?) *necrophila* (G. S. I. No. D 243).	..	..	..	..	20·4	7·4	..	..	..	..	..	..	..	..	..	..
Eomellivora (?) cf. *necrophila* (G. S. I. No. D 254).	11·7	27·0	..	..	21·9	7·4	12·1	..	8·2	..	6·4	..	4·2	..	13·1	..
Eomellivora (?) cf. *necrophila* (G. S. I. No. D 255b).	..	..	..	..	..	..	13·1	7·0	..	..	..	..	..	..	..	..
Eomellivora (?) sp. (G. S. I. No. D 256b).	..	..	..	..	..	..	14·5	7·2	..	..	..	..	..	..	..	..
Lutrine gen. indet. *furtivus* (G. S. I. No. D 239).	7·1	13·3	2·6	2·1	10·4	5·2	7·3	4·2	5·5	3·1	..	..	..	..	..	..
Lutrine gen. indet. *hasnoti* (G. S. I. No. D 135).	9·4	17·2	..	..	14·5	7·5	11·2	5·5	..	..	..	..	..	..	..	..
Enhydriodon cf. *falconeri* (G. S. I. No. D 161).	..	..	..	..	21·6	12·7	..	..	..	..	..	..	..	..	..	..
Sivaonyx bathygnathus (G. S. I. No. D 156).	10·7	18·7	..	..	16·0	9·4	9·7	5·8	7·1	..	5·5	..	1·9		..	..
Sivaonyx bathygnathus (G. S. I. No. D 250).	9·6	18·8	5·7	5·3	16·4	9·1	..	..	..	..	..	..	..	..	..	..
Sivaonyx bathygnathus (G. S. I. No. D 244).	11·8	21·9	..	..	..	..	10·1	6·4	6·4	..	5·5	..	..	..	9·8	7·6
Sivaonyx bathygnathus (G. S. I. No. D 249).	9·1	18·1	..	..	14·2	8·3	..	..	..	..	..	..	..	..	..	..
Vishnuonyx chinjiensis (G. S. I. No. D 245).	7·0	14·0	5·0	3·3	11·7	..	7·3	4·2	..	..	..	..	..	..	..	..

Measurements of Indian Fossil Mustelidae (*Upper Dentition*).

Eomellivora (?) [illegible] (G. S. I. No. D 256*a*).	..	..	..	..	..	..	..	..	16·4	8·8	..	..	..	..	..	..
Sivaonyx bathygnathus (G. S. I. No. D 157).	..	..	..	..	..	..	14·4	13·2	..	..	..	..	..	..	..	..
Vishnuonyx chinjiensis (G. S. I. No. D 223).	..	..	..	..	..	..	app. 11·3	app. 8·8	..	..	..	..	..	..	..	..
Sivalictis natans (G. S. I. No. D 227).	..	..	..	..	14·7	20·6	..	..	..	..	..	..	..	..	..	..
Gen indet. sp. indet. (G. S. I. No. D 128).	..	..	..	..	..	..	app. 24·3	15·6	..	..	..	..	..	..	..	..
Gen. indet. sp. indet. (G. S. I. No. D 207).	..	..	..	..	..	..	..	app. 13·3	13·4	7·7	6·2	5·7	absent		16·8	10·5

Sub-family: *MUSTELINÆ.*

Diagnosis.—Mustelidae with P^4 elongated, with short protocone; M^1 shorter than P^4, tritubercular, protocone conical or ridge-like; M^2 absent except in certain early forms; M_1 with metaconid small or absent, talonid not more than half the total length of the tooth, basin-shaped or trenchant; feet with the exception of *Gulo* and its allies digitigrade and cursorial.

Remarks.—Most authors have included the genera *Mustela* and *Putorius* in the same sub-family as *Martes.* Pocock (1921, p. 832) separates them mainly on the structure of the auditory bulla, though he admits that the thickening of the walls of the bulla of *Martes* might have given rise to a bulla like that of *Mustela.* In view of the diversity which is found in fossil species, it seems impossible at present to split these genera into two sub-families. *Gulo* has often been regarded as belonging to a different sub-family from *Martes,* but Pocock has emphasised (1920, p. 187) the similarity between them. On the contrary he assigns sub-family rank to *Mellivora,* often put with the Melinæ (Schlosser, 1923, p. 475) and this seems to me the wisest course. Abel (Weber, 1928, p. 333) classifies *Mellivora* as one of two groups within the sub-family Mustelinæ, but except in this I follow his classification.

The *Mustelinae* are in many respects the most primitive of the Mustelidæ, and still retain structures which have been lost in the later members of other sub-families. In this connection it is of interest to note that Pocock for zoological reasons has affiliated the Lutrinæ with the Mustelinæ and the fossil evidence seems distinctly to support that view.

Genus: SINICTIS, Zdansky.

1924. *Sinictis,* Zdansky, *Pal. Sin.* ser. C. II, fasc. i, p. 28, Pl. vi, figs. 1-4.

Diagnosis.—Mustelinae with narrow, moderately high skull with rather elongated pointed muzzle; M^1 no longer internally than externally, protocone ridge-like; mandible very elongated and slender; M_1 with a strong metaconid and a trenchant talonid.

Genotype.—*Sinictis dolichognathus,* Zdansky (1924, p. 28, Pl. vi, figs. 1-4).

Remarks.—This genus seems to be distinguished from *Martes* mainly by the talonid of M_1 being trenchant instead of basin-shaped and from *Mustela* by the presence of a metaconid on M_1 and by the more pointed muzzle. The structure of M^1 is more primitive than that of *Martes* and *Mustela* and most other of the later genera in the simpler constitution of the protocone and in the smaller internal diameter of the tooth.

Species.—Zdansky did not refer any other species to this genus except *S. dolichognathus.* Elsewhere (Pilgrim, 1931, p. 38) I have discussed the propriety of including in it *Mustela pentelici,* Gaudry (1862, p. 42) from Pikermi; *Mustela* sp., Lydekker (1885, p. 177), to which I now give the specific name *lydekkeri,* from the Siwalik Hills: and the smaller species *Mustela* (?) *jägeri,* Schlosser (1902, p. 148), from the Bohnerz of Salmendingen.

SINICTIS (?) LYDEKKERI, sp., nov.

1885. *Mustela* sp., Lydekker, Cat. Foss. Mamm. Br. Mus., I, p. 177, text-fig. 25.
1931. *Sinictis* (?) sp., Pilgrim, Br. Mus. Cat. Pontian Carnivora of Europe, p. 38.

Diagnosis.—A *Sinictis* of approximately the same size as *S. dolichognathus;* mandible rather stouter, intermediate in depth between *S. dolichognathus* and *S, pentelici;* M_1 with a strong metaconid; talonid longer than in the other species; hypoconid high, immediately behind the protoconid; with a small internal shelf.

Holotype.—The fragmentary left mandibular ramus described and figured by Lydekker (1885, p. 177, text-fig. 25) under the name of *Mustela* sp. It is in the British Museum regd. no. 15914.

Locality.—The Siwalik Hills.

Horizon.—Uncertain, but probably from the Pinjor stage of the Upper Siwaliks.

Remarks.—Little need be added to Lydekker's description of the holotype, or to the comparisons which he has made with numerous recent and fossil species which more or less resemble it. Its measurements are given below. The M_1 is in a fairly advanced stage of wear, which has considerably diminished the height of the two external cusps of the trigonid and that of the talonid. The metaconid is strong and rather widely separated from the protoconid, occupying a position distinctly to the rear of the latter cusp. The talonid is rather more than two-thirds the length of the trigonid and consists of a high trenchant cusp, hypoconid, which continues the line of the protoconid. Its wear seems to indicate that this cusp had a subsidiary peak posteriorly, from which a well marked but low and narrow cingular shelf runs along the internal margin of the talonid.

The coexistence of a metaconid with a submedian trenchant hypoconid are characters which this species shares with *Sinictis dolichognathus*, Zdansky and *Mustela pentelici*, Gaudry, and have led me (Pilgrim 1931, p. 38) provisionally to refer the latter species to the genus *Sinictis*, in spite of its deeper ramus. The depth of the Indian ramus is intermediate between that of the other two species, being rather less than the length of M_1. The talonid is longer than in either of the others, and the internal shelf is possibly more definite. Both the ramus and M_1 are somewhat more stoutly built than in *Sinictis dolichognathus*. The differences noted are amply sufficient to distinguish the Indian ramus specifically, but in the absence of more complete material, I cannot regard them as affording a reasonable excuse for separating it generically from *Sinictis*, to which accordingly I shall provisionally refer this species.

Measurements.

P_4 ant. post. diam.	5·5 mm.
M_1 ant. post. diam.	12·0 mm.
trans. diam.	5·0 mm.
Depth of ramus beneath M_1	11·5 mm.

Sub-family: *MELLIVORINÆ*, Pocock.

Diagnosis.—Mustelidæ with auditory bulla not extremely flattened, elongate, encroaching on glenoid, divided by an imperfect septum into two chambers, of which the posterior one is not multilocular; cavity of bulla opening into a fairly large hollow space in the mastoid portion of the periotic; mastoid and paroccipital processes somewhat remote from bulla; occipital crest inclined backwards and inwards from mastoid, rather flattened in back view; palate much extended behind the molars; M^1 with transverse much exceeding antero-posterior diameter, with small outer and larger inner lobe, metacone absent or rudimentary, protocone simple, no hypocone, well-developed inner cingulum; M^2 absent; premolars stoutly built, broad; P^4 long, antero-posterior diameter much exceeding that of M^1, with protocone situated far forward; P^1 and P_1 lost in most advanced members; M_1 long but progressively shortening, without metaconid; talonid short, less than one-third the length of the entire tooth, with rather stout, trenchant hypoconid, no entoconid; M_2 present in primitive, lost in advanced members; limbs short; feet semi-plantigrade.

Genus: MELLIVORA, Storr.

1780. *Mellivora*, Storr, Prodromus, Method. Mamm., p. 34, tab. A.
1830. *Ratelus*, Bennett, Gardens and Men. Zool. Soc. I, pp. 13-20.
1835. *Ursitaxus*, Hodgson, *Journ. As. Soc. Beng.*, IV, pp. 522, 564.

Diagnosis.—Mellivorinæ with skull rather depressed; brain case long and much expanded laterally; mastoid process prominent, laterally extended; paroccipital process prominent, high; muzzle short and relatively narrow; face low; infra-orbital foramen small, frequently duplicated; teeth rather brachydont; M^1 much extended transversely; P^4 large, rather stoutly built, with large anteriorly placed protocone; P^2 and P^3 rather broad; P^1 absent; mandible stoutly built, with large, well defined masseteric fossa; symphysis deep, more so than ramus under M_1; M_1 stoutly built, with short, low, trenchant talonid; M_2 absent; lower premolars broad, with well marked accessory cusps and cingula; P_1 absent.

Genotype.—Mellivora ratel, Sparrmann, living in the Cape of Good Hope.

MELLIVORA SIVALENSIS (Falconer and Cautley).

1836. *Gulo* sp., Baker and Durand, *Journ. As. Soc. Beng.*, V, p. 581, Pl. xxvii, figs. 4-8.
1868. *Ursitaxus sivalensis*, Falconer, Pal. Mem. I, p. 553, description of unpublished Pl. Q, fig. 4.
1884. *Mellivora sivalensis* (Falc. & Caut.), Lydekker, *Pal. Ind.*, (10), II, p. 180, Pl. xxvi, figs. 1-4, and text-fig. 1, p. 182.

Diagnosis.—A *Mellivora* of about the same size as *M. indica*; with fronto-parietal region flatter and more depressed; frontals wider between the orbits; auditory bulla slightly more inflated; mastoid process more prominent and lying more in the horizontal plane; paroccipital process stouter and less pointed; palate less extended behind the molars; M^1 less expanded internally; P^4 with blades longer and more compressed and protocone slightly more anterior; P^3 longer and more compressed; mandible with narrower and deeper masseteric fossa; teeth forming a curve, concave on the inner side; P_4 more compressed; P_3 larger and more pointed anteriorly.

Holotype.—The skull described and figured under the name of *Gulo* sp. by Baker and Durand (1836, p. 581, Pl. xxvii, figs. 4, 5, and 8), which is in the Science and Art Museum in Dublin, regd. no. 45. The right half of the palate was also figured by Lydekker (1884, p. 182, text-fig. 1).

The Dublin skull is undoubtedly the holotype of the species, since it is specifically referred to in the description of an unpublished plate Q of the Fauna Antiqua Sivalensis in Falconer's Palæontological Memoirs I, p. 553, where it is named *Ursitaxus sivalensis.* It is true that the editor of Falconer's Palæontological Memoirs considered that the unpublished figures were of the same specimen as that figured by Baker and Durand. This is not the case, the unpublished figures being of Br. Mus. skull no. 40184, which is quite different, at any rate in its state of preservation, from the Dublin skull. It is also true that Baker and Durand mentioned the British Museum skull, and figured it from the side in their fig. 7. We are, however, bound to accept the Dublin skull as the holotype, since it was the only specimen of which complete descriptions and figures existed at the time when the name *Ursitaxus sivalensis* was given, and that name was definitely applied to it. Lydekker, who copied the original plate Q figures of Br. Mus. no. 40184 in 1884 (Pl. xxvi, figs. 1-4) chose (1885, p. 188) to regard that skull as the holotype, but incorrectly so according to the now accepted laws of nomenclature. Apart from this the Dublin skull is more fitted to be the holotype, since it is better preserved than the British Museum skull and was moreover associated with a mandible which probably belonged to the same individual.

Referred specimens.—Both rami of a mandible appear to have been associated with the holotype skull, though not attached to it. Baker and Durand definitely referred them to the same individual. The right ramus was figured by Baker and Durand (Pl. xxvii, fig. 6) and the left one by Lydekker (1884, text fig. 1, p. 182).

The second skull mentioned by Baker and Durand and figured in side view (Pl. xxvii, fig. 7) is in the British Museum (no. 40184). It was figured completely by Lydekker (Pl. xxvi, figs. 1-4).

Locality.—All the specimens were found in the Siwalik Hills. One of the skulls, probably Br. Mus. no. 40184, is recorded by Baker and Durand (1836, p. 489) to have been excavated at Moginand. No locality is recorded for the other.

Horizon.—On the assumption that both the skulls belong to the same level as that of the one found at Moginand, we may regard the horizon as the Pinjor stage of the Upper Siwaliks.

Remarks.—Baker's and Durand's original description, quoted in Falconer's Palæontological Memoirs (I, p. 339), was amplified by Lydekker (1884, p. 180) and by Matthew (1929, p. 466). There is nothing to be added to what these authors have written. Matthew considers that the teeth are very distinctly more primitive than either of the recent species, but that the cranial characters mentioned in the diagnosis are probably those of the male, since he has found them in a modern male skull. Lydekker considers that the holotype skull does not differ essentially from the referred skull except by its slightly larger size, which is likely to be due merely to individual or sexual variation.

Genus : PROMELLIVORA, nov.

Diagnosis.—Mellivorinæ with short mandible; symphysis long, extending back to the hinder edge of P_3; lower border of ramus slightly concave, anterior end shallower and less abrupt than in *Mellivora*; two large mental foramina, one beneath P_2 and one beneath the hinder half of P_4; with additional smaller foramina; M_1 relatively long with very compressed blade; P_4 relatively short with anterior and posterior cingula short, but with strong posterior accessory cusp placed very internally to the main cusp; P_3 small and compressed; P_2 small, lying very obliquely in the jaw; P_1 one-rooted; canine large, rather procumbent; I_3 slightly larger than I_2; skull characters unknown.

Genotype.—*Mellivora punjabiensis*, Lydekker (1884, p. 183, Pl. xxvii, fig. 6).

Remarks.—The genus agrees with *Eomellivora* in the presence of P_1, by the length and slenderness of M_1 and in the large canine, but differs in the shorter and shallower ramus, the long gradually sloping symphysis and the smaller size of the anterior premolars. From *Mellivora* it is distinguished by the presence of P_1, the shallower and more gradual symphysis, the length and compression of M_1 and the shorter and simpler premolars especially P_3 and P_2, and the larger canine.

PROMELLIVORA PUNJABIENSIS (Lydekker).

1878. *Mellivora sivalensis* (Falc. & Caut.), Lydekker, *Rec. Geol. Surv. Ind.*, XI, p. 102.
1884. *Mellivora punjabiensis*, Lydekker, *Pal. Ind.*, (10), II, p. 183, Pl. xxvii, fig. 6.

Diagnosis.—This is the only known species and the characters are those of the genus.

Holotype.—The fragmentary right mandibular ramus in the collection of the Geological Survey in Calcutta, regd. no. D 20, which was described and figured by Lydekker (1884, p. 183, Pl. xxvii, fig. 6).

Locality.—Hasnot, Jhelam district, Salt Range.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Remarks.—The holotype ramus is extremely meagre material on which to found a new genus. In view of the fact that Lydekker has definitely assigned it to *Mellivora* without even querying the reference, this, however, seems the procedure best calculated to remove the mistaken idea that the living genus *Mellivora* occurs in the Middle Siwaliks, since the holotype certainly does not belong to *Mellivora*, and its characters, deficient as they are, do not agree with those of any other known genus, so far as I am aware.

Lydekker (1884, p. 184) remarks 'The shape of the jaw and the number and form of the cheek teeth conclusively show that the specimen belongs to a species of ratel of about the same size as the living species and *Mellivora sivalensis*'. These statements are only partially true. The removal of some adhering matrix which obscured the alveoli between the canine and P_3 at the time of Lydekker's examination shows conclusively that there are three alveoli of which the most anterior is of a moderately large size and is situated immediately behind the canine; it obviously contained the root of a one-rooted P_1. The middle one of the three alveoli is the smallest of the three and lies external to and only slightly more forward than the hindermost alveolus, so that P_2 was placed obliquely in the jaw and was broader behind than in front precisely as in the genus *Mellivora.* The presence of P_1 is, however, a primitive feature which distinguishes our form from the recent genus. Another feature which marks it off from *Mellivora* is the longer symphysis; this extends back as far as the hinder edge of P_3 instead of only to the hinder edge of P_2 as in the recent genus. The large canine and the minute P_3 mentioned by Lydekker may also possess generic significance. The summit of P_4 is broken but the presence of a constriction in the cross section of the fractured surface suggests that a posterior cusp may have been present. A cingulum surrounds the tooth everywhere but it is less broad than in *Mellivora indica.* It is uncertain whether an anterior cusp was present or not. The width of the tooth invites a comparison with that of *Mellivora* rather than with that of *Gulo,* in which P_4 is relatively more slender, has a less continuous cingulum and only very obscure accessory cusps. M_1 was undoubtedly a slender tooth and it is unlikely that a metaconid existed. The fracture behind the trigonid leaves the exact structure of the talonid in doubt, but it could not have been expanded as in *Gulo.* The presence or absence of M_2 is equally impossible to ascertain. There is a mental foramen beneath P_2 and two close together beneath P_4. As Lydekker has remarked, only two incisors are visible, their roots lying abreast of each other; they are of approximately equal size and about as large as I_3 in *Mellivora indica.*; I_1 has left no trace of its presence. The specimen agrees with *Eomellivora* in regard to the slenderness of M_1, but the excessively broad P_4 distinguishes it from *Eomellivora,* especially from the Chinji species *Eomellivora* (?) *necrophila.* Equally does the small size of the three anterior premolars give them a different aspect from the longer ones of *Eomellivora* (?) *necrophila* or the broadly expanded ones of *Eomellivora wimani.* The long sloping symphysis and the shallower ramus distinguish it from *Eomellivora wimani* but less so from *Eomellivora* (?) *necrophila.*

Thus the structure of the teeth, so far as one can infer it, seems to be decidedly nearer to *Mellivora* than to any other genus. The presence of P_1, the long symphysis and the small size of P_3 prohibit the generic identity of the Hasnot ramus and that of the ratel. The differences from the Upper Siwalik *Mellivora sivalensis* are of the same nature as those which distinguish it from the recent species, but the disproportion in size between P_3 and P_4 is even greater when a comparison is made with the Upper Siwalik species. Since, however, it is not improbable that the three forms are on the same line of descent, it will not perhaps be inappropriate to recognize this by choosing as a generic designation the name *Promellivora* for the most primitively constituted of the three.

Genus: EOMELLIVORA, Zdansky.

1924. Zdansky, *Pal. Sinica*, ser. C, II, fasc. 1, p. 61.

Diagnosis.—Mellivorinæ of large to very large size with high face and rounded frontals; teeth crowded; with relatively higher crowns than in *Mellivora*; M^1 with three cusps defined, of which the metacone is only rudimentary; well marked internal and external cingula; P^4 stoutly built, with protocone slightly contracted between the inner side and the paracone; anterior upper premolars broader than long in the genotype) probably longer than broad in *E.* (?) *necrophila*); P^1 a one-rooted, fully functional tooth; P^2 triangular, without accessory cusps but with cingula; P^3 triangular with weak anterior and posterior accessory cusps and strong cingula; upper canine strong; mandible deep with a steep and deep symphysis, a long mental foramen or two close together extending from the front edge of P_2 to below the middle of P_3 and another under the front part of P_4; M_2 one-rooted, oval, consisting of a flat longitudinal crest forming a weak cusp in the middle; M_1 very elongate, compressed, with talonid consisting of a single median not very compressed ridge-like cusp (hypoconid); P_4 relatively elongated, broader behind than in front, with a rather compressed main cusp, anterior and posterior accessory cusps and strong cingula; $P_{1\text{-}3}$ broad, triangular in the genotype, elongate in *E.* (?) *necrophila*, with accessory cusps weaker than in P_4 or absent; lower canine large, oval in cross-section, without keels.

Genotype.—Eomellivora wimani, Zdansky (1924, p. 61, Pl. xi, figs. 5, 6; Pl. xii, figs. 1, 2).

EOMELLIVORA (?) NECROPHILA, sp. nov.

(Pl. III, figs. 4-7).

Diagnosis.—An *Eomellivora* of smaller size than *E. wimani*; with a deep symphysis descending at an angle of 45° to a level with the hinder end of P_2 and then vertically to the lower edge of the ramus; chin very much less steep than in *E. wimani*; lower border of ramus almost horizontal; deep masseteric fossa; with a marked depression on the internal side of the ramus beneath M_1, bounded below by a slightly projecting rim which causes the lower surface of the ramus beneath and behind M_1 to be broad and somewhat flattened; M_1 with high protoconid, paraconid relatively slightly lower and talonid relatively slightly shorter than in *E. wimani*; M_2 relatively larger than in *E. wimani*; P_3 and P_4 with posterior much larger than anterior root, but relatively much narrower than in *E. wimani*; P_2 elongate, not triangular; P_1 single-rooted, oval, slightly elongate in an antero-posterior direction; canine relatively larger than in *E. wimani*: skull and upper dentition unknown.

Holotype.—The isolated M_1 described below and figured in Pl. iii, fig. 5, 5a. This is in the collection of the Geological Survey of India in Calcutta, regd. no. D 243.

Referred specimens.—The left mandibular ramus (G. S. I. no. D 254) showing the roots or broken bases of the crowns of all the teeth, described below and figured in Pl. iii, figs. 7, 7a.

Associated with the holotype were a few small teeth, amongst which were the hinder part of an M_1 (G. S. I. no. D 255a), two lower premolars (G. S. I. nos. D 255b and 256b) figured in Pl. iii, figs. 4, 6 and an upper premolar (G. S. I. no. D 256a, figured in Pl. iii, fig. 3. They do not belong to the same individual since M_1 is slightly larger than the holotype, and the two lower premolars do not correspond exactly in size with one another. In certain other respects the M_1 is not identical with the holotype, so that it is not unlikely that there are two species represented. Since, however, all the material is so fragmentary, it is not worth while to found another species. At the same time the association furnishes valuable evidence for the reference of the ramus D 254, which otherwise I could hardly have ventured to unite with the holotype.

Locality.—The holotype and the associated teeth were collected near the village of Bhilomar to the west of Chinji in the Salt Range. The ramus was found south of Chinji.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The holotype contains a single tooth, which is still embedded in a fragment of the ramus. This is obviously a left M_1, and consists of three cusps, paraconid, protoconid and hypoconid. All three have been slightly diminished in height by attrition against the upper teeth, but the wear seems to be most marked in the case of the paraconid. The hypoconid and the protoconid are in the same straight line and the paraconid is slightly oblique to them. The protoconid is much the highest of the three in the present condition of the tooth, but if it had been quite unworn, it is probable that the difference in height between the paraconid and the protoconid would not have been so marked. The hypoconid is the lowest of the three. It is very elongated and compressed. The protoconid is longer than the paraconid and the hypoconid is shorter than the paraconid. There is no trace of a metaconid. The protoconid is rather sharp, and its anterior and posterior keels descend rather steeply, in the former to a deep notch which separates it from the paraconid, in the latter to a less distinct notch which separates it from the hypoconid. The hypoconid is the only cusp, of which the talonid consists, there being no entoconid, but a small yet distinct cingulum exists on the inner side. The summit of the hypoconid is rather trenchant than pointed and the outer side is steeper than the inner side. There is a large facet of wear at the hinder end, which shows that a rather large M_2 existed. The measurements of this and the referred specimens are collected on page 60.

Of the associated specimens a fragment of M_1 (G. S. I. no. D 255a) shows only the talonid, which agrees so closely with the holotype even to the presence of a precisely similar internal cingulum that there can be little doubt that they are generically, if not specifically identical. The length, breadth and height of the talonid are respectively 5·5 mm.; 6·1 mm.; and 5·1 mm.; as contrasted with 4·9 mm.; 6·0 mm.; and 4·8 mm. in the case of the holotype. This specimen is, therefore, slightly larger than the holotype and had a relatively longer talonid, but the difference may be only individual.

The two lower premolars (G. S. I. nos. D 255b and 256b), figured in Pl. iii, figs. 4 and 6 respectively, not only differ in size but are also in quite different stages of wear. The dimensions of the larger one are 14·5 mm. long and 7·2 mm. broad. This tooth has two roots, of which the posterior is larger than the anterior one, there is a strong posterior accessory cusp and a much smaller anterior one; there is no cingulum. The smaller of the two, which is also in a much more advanced stage of wear, is 13·1 mm. long and 7·0 mm. broad. The cusps are very similar, but there is a well marked cingulum on all sides of the tooth. It is in the highest degree unlikely that they belong to the same individual, and they are probably both P_4. Their differences incline one to think that they represent two allied species.

The tooth figured in Pl. iii, fig. 3 (G. S. I. no. D 256a) is embedded in a small portion of the left maxilla, and is evidently P^3. It lacks the summit of the protocone and the upper surface of the anterior portion of the crown. It is very elongate and is expanded near the postero-internal corner but there is no separate root. There is a strong posterior accessory cusp and a marked internal cingulum, extending to the front margin. The broken condition of the tooth deprives us of information as to its presence externally, and equally as to the existence of an anterior accessory cusp. This tooth may not belong to the same species or even genus as the lower P_4 (D 256b), but its Mellivorine affinity is at any rate conceivable.

Finally there is the ramus (D 254), which was not found with the other specimens. This lacks the angle, condyle and coronoid process, but all the teeth are represented by their roots, although the crowns themselves are completely shattered. M_1 is an extremely elongate, compressed tooth, with a long talonid. It agrees so closely both in size and outline with the holotype that this fact alone suggests specific identity. The alveolus of M_2 is not complete behind, but it evidently was a large somewhat elongate tooth. The four premolars are crowded, there being no diastemata. P_{2-4} are elongate teeth, with the posterior root larger than the anterior one. P_3 lies somewhat obliquely in the jaw. P_1 is a single-rooted, slightly elongate, oval tooth. The canine is extremely large, of an oval cross section, without keels. Since the incisors are only represented by roots or alveoli, and since the cavities are not clearly defined, one cannot draw precise conclusions as to their size. I_1 appears to have been small and compressed laterally. I_2 occupies an extremely backward position opposite the mid point of the canine. I_3 was probably somewhat enlarged. The ramus is moderately slender, with a very slightly concave lower border, a deep symphysis, the depth below P_2 being equal to that under M_1. The symphysis descends at an angle of about 45^0 as far as the middle of P_2 and then vertically to the lower border. The chin slopes backward at a very gentle angle far removed from the vertical. There are two closely juxtaposed, partially fused mental foramina extending from in front of to behind P_2. The anterior one is the smaller of the two. There is probably another one beneath P_4, but the broken surface of the jaw does not permit of exact observation. The masseteric fossa is extraordinarily deep with well defined abrupt edges. There is a marked depression on the inner surface of the ramus beginning under P_4 and extending behind M_1. This depression is accentuated by a projecting rim which separates the inner from the lower surface of the ramus and produces a flattening and stoutening of the latter from about the mid point of M_1 backward.

Comparisons.—Viewed as an isolated specimen the holotype closely resembles the M_1 of *Eomellivora wimani*, Zdansky (1924, p. 61) from China both in regard to size and structure. It is slightly smaller, the protoconid is taller and the talonid has a small internal cingulum, which is absent in the Chinese species. The two species agree in the absence of a metaconid, the rather high trenchant talonid and the elongated, slender form of the tooth. Of other known genera which also have no metaconid, *Gulo, Megalictis* and *Aelurocyon* have a much stouter M_1 with a much expanded inner border. The talonid of *Gulo* is particularly broad and low and that of *Aelurocyon* is much too short. M_1 of *Mellivora* and *Promellivora* is much shorter and also too broad, with a shorter, lower and more pointed talonid. M_2 is also missing. The species of *Bunœlurus* are small-sized Oligocene forms, with a very short talonid. *Palœogale* is like *Bunœlurus* and probably not generically separable from it. *Putorius* and *Ictonyx* are small animals with a much broader internal cingulum.

The referred ramus (D 254) presents a sufficient number of Mellivorine characters, some of which are clearly reminiscent of *Eomellivora,* to justify us in regarding the precisely similar outline of M_1 as strong evidence in favour of specific identity with the holotype. Of the two specimens of P_4 which were associated with the holotype, the smaller (D 255b) corresponds well with the roots in the Chinji ramus, while the larger one (D 256b) seems almost identical with the corresponding tooth of *Eomellivora wimani.* The deep and slender ramus; the steep symphysis; the numerous mental foramina; the deep masseteric fossa; the slender M_1 with its narrow talonid; and the large canine and M_2 are characters which it shares with *Eomellivora wimani* in distinction from *Mellivora, Promellivora* and *Gulo.* On the other hand although the larger posterior roots of the premolars indicate a probable tendency to lateral expansion, yet such an expansion has clearly not taken place to anything like the extent which we find in $P_{1\text{-}3}$ of *Eomellivora* and in a less degree in *Mellivora* and *Promellivora.* In the sloping chin it differs both from *Mellivora* and *Eomellivora* and is more like *Promellivora.* The absence of P_1 and M_2 in *Mellivora* and the reduction in size of the anterior premolars in both *Mellivora* and *Promellivora* clearly indicate that both these genera are in a more advanced stage of development than the Chinji ramus. I can also imagine that the ancestral form which gave rise to *Eomellivora wimani* may have had the anterior premolars less expanded and more like those of the Chinji ramus. I do not mean to imply by this that it is not entitled to generic separation from *Eomellivora.* On the contrary if it could be conclusively proved that the ramus was specifically identical with the holotype, I should unhesitatingly advocate the use of a different generic name, but as the uncertainty exists it seems better provisionally to adopt the queried reference to *Eomellivora.* It cannot be denied that there are resemblances between the Chinji ramus and that of *Gulo luscus.* The living species often shows a similar flattening of the lower surface of the ramus in its hinder portion, and the lower border is not unlike that of the fossil. It is not altogether inconceivable that the slenderness both of the ramus and the teeth might mark an ancestral stage leading to *Gulo.* The flatter symphysis of *Gulo,* the shallower ramus, the absence of the internal depression beneath M_1, the equality in size of the roots of the premolars and finally the fact that the only Pontian Guline species so far discovered, the Chinese *Plesiogulo brachygnathus* Zdansky, has a metaconid in M_1; all these militate somewhat against the affinity suggested.

EOMELLIVORA (?) TENEBRARUM, sp. nov.

1884. *Mellivorodon palæindicus,* Lydekker, *pars, Pal. Ind.,* (10), II, p. 185, pl. xxvii, fig. 8.

Diagnosis.—An *Eomellivora* (?) of approximately the same size as *Eomellivora wimani*; with shallower ramus; without a depression on the internal surface; M_1 relatively slightly longer, and narrower; hypoconid lower and less compressed than in *Eomellivora wimani* or *Eomellivora* (?) *necrophila.*

Holotype.—The hinder portion of a left mandibular ramus described and figured by Lydekker (1884, p. 185, Pl. xxvii, fig. 8) under the name of *Mellivorodon palæindicus.* The specimen is in the collection of the Geological Survey of India in Calcutta, regd. no. D 22.

Locality.—Niki, Salt Range.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Remarks.—Lydekker referred the holotype to *Mellivorodon palæindicus* and in part based on it his description of the latter species. He was also no doubt largely guided by the shape of the talonid of M_1 of this specimen in forming an opinion as to the taxonomic position of *Mellivorodon palæindicus,* that part being missing in the holotype of that species.

Matthew (1929, p. 468) observes that 'there is no evidence that the second jaw fragment attributed to *Mellivorodon* belongs to it or is in any way related to or resembling it save for the quite uncharacteristic features of being about the same size and having about the same width of blade in the carnassial (a character repeated in numerous genera of several families).' I had for a long time independently held the same view as Matthew. Actually the ramus now designated as *Eomellivora* (?) *tenebrarum* is too deep and stout to have belonged to the same species as *Mellivorodon palæindicus,* and its lower surface beneath M_1 differs entirely in appearance, being rather flattened instead of keeled. Matthew has pointed out that *Mellivorodon palæindicus* shows distinct Felid affinities, while, in my opinion, the talonid of M_1 of the present species shows distinct signs of relationship to Mellivorines or Gulines, especially to *Eomellivora wimani,* and still more so to the remains described above under the name of *Eomellivora* (?) *necrophila.* Had it not been for the existence of the ramus and M_1 from Chinji belonging to the latter species, I should have been inclined, like Matthew, to regard the present ramus as indeterminate, but since the occurrence of an allied form to *E.* (?) *necrophila* at a higher horizon than that of Chinji, may be of some importance, it seems better that the specimen should not be lost sight of, to avoid which, I have given it a distinct specific name.

While feeling reasonably certain that it differs from any hitherto described species, I am by no means sure that its affinities are not with *Gulo* rather than with *Mellivora.* The apparently lower hypoconid than in either *Eomellivora wimani* or *E.* (?) *necrophila* is closer to that of *Gulo luscus.* It is, however, quite possible that the lowness of the hypoconid is an illusion produced partly by more advanced wear but chiefly by intense weathering, of which the specimen bears undoubted traces. In this case the specimen if fresh might not have been very unlike the Chinji M_1 (G. S. I. no. D 243) of *E.* (?) *necrophila.* The inner side of the talonid is more like that of the Chinji than the Chinese species, but the cingulum, if such existed in the Niki M_1, which cannot be ascertained, must have been situated at a greater distance above the base of the crown. Relatively to the length of M_1, the ramus is shallower than the Chinji ramus (G. S. I. no. D 254) and lacks the depression on the internal surface. The extreme narrowness of M_1 gives it a markedly different appearance from M_1 in *Gulo luscus,* although it cannot be predicated that an ancestral form of *Gulo* could not have had equally narrow teeth. If, however, we take into account the Pontian forms known to belong to these two lines, *Eomellivora* and *Plesiogulo,* it is with the former that the closest resemblances lie.

Sub-family : *LUTRINÆ.*

Diagnosis.—Mustelidae modified for aquatic life in many parts of the skull and skeleton ; limbs shortened ; feet flattened ; articulations of the foot bones loosened ; skull with much expanded brain case, contracted behind the orbits ; muzzle progressively shortening ; auditory bulla progressively depressed ; P^4 with metacone progressively shortening, protocone progressively lengthening ; until in the later genera it is coextensive with the outer wall of the tooth and has its inner border almost parallel to the outer wall of the tooth, a ridged ring or cusps being simultaneously developed ; M^1 tritubercular, short and triangular in the earlier genera, progressively becoming rectangular and longer through the development of a posterior and internal cingulum ; M_1 with strong metaconid ; trigonid becoming progressively shorter and lower ; talonid broad, primitively with an outer trenchant ridge, sloping to the inside, in some genera inner edge of talonid developing a ring of cusps so that the talonid becomes basin-shaped.

Genus : LUTRA, Erxleben.

1777. *Lutra,* Erxleben, Syst. regn. anim. Cl. I, Mamm. p. 445.

Diagnosis.—Lutrinae of small to medium size ; skull with a rather strongly flattened brain—case ; upper profile more or less rectilinear ; muzzle narrow, obliquely cut away in front ; nasal opening small ; interorbital breadth less than that at the muzzle ; palate relatively rather short, extending less than 15 mm. behind the molars ; infra-orbital foramen larger than the canine alveolus ; cheek teeth trenchant, rarely broadened, with relatively high narrow cusps ; P^4 inner side about two-thirds the antero-posterior diameter of the outer side, rarely less or more; outer cusps trenchant; only one inner cusp; M^1 with antero-posterior diameter two-thirds or more of the transverse diameter; with weak parastyle not developed as a cusp; mandible depth less than the length of M_1; M_1 with trenchant cusps; talonid equal in length to trigonid, but narrower; strong, high, trenchant hypoconid; entoconid represented by a low narrow cingulum; in the *sumatrana* group the inner cingulum (entoconid) is almost as high as the hypoconid; M_2 small, circular, twice as broad as long; P_4 not especially broadened behind, without accessory cusps (adapted from Pohle).

Genotype.—Mustela lutra, Linné.

LUTRA PALÆINDICA, Falconer and Cautley.

1868. *Lutra palaeindica* Falconer, Pal. Mem. I, p. 552, Pl. xxvii, figs. 6-8.

1880. *Lutra palaeindica,* Falc. and Caut., Bose, *Quart. Jour. Geol. Soc. London,* XXXVI, p. 133.

1884. *Lutra palaeindica,* Falc. and Caut., Lydekker, *Pal. Ind.,* (10), II, p. 190, Pl. xxvii, figs. 1, 2, 2a.

Diagnosis.—A *Lutra* of rather smaller size than *L. sumatrana* or *L. nair*; skull relatively shorter than in *L. sumatrana* or *L. nair*; brain case relatively wider and more flattened than in *L. nair*; temporals less contracted behind the orbits; post-orbital processes relatively more prominent; muzzle narrower, only slightly exceeding breadth at post-orbital processes; face and dental series relatively longer than in *L. sumatrana*; P^4 with inner side relatively shorter than in *L. sumatrana*; M^1 shorter especially on the inner side; M_1 with stronger and higher hypoconid than in *L. sumatrana.*

Holotype.—The skull figured by Falconer (1868, Pl. xxvii, figs. 6, 7) and described first by Bose (1880, p. 133) and subsequently by Lydekker (1884, p. 190, Pl. xxvii, fig. 1) and by Pohle (1919, p. 41, Pl. ii, fig. 5). It is in the British Museum, regd. no. 37151.

Referred specimen.—The left mandibular ramus (Br. Mus. no. 37152) figured by Falconer (1868, Pl. xxvii, fig. 8) and described and figured by Lydekker (1884, p. 192, Pl. xxvii, figs. 2, 2a) and referred by both authors to the same species as the holotype.

Locality.—The Siwalik Hills.

Horizon.—Upper Siwalik, probably not older than the Pinjor stage, but the level is uncertain.

Remarks.—Lydekker has compared this species with the various living Indian species of otter and with *L. sumatrana* and endorsed Falconer's and Bose's opinion that it was specifically distinct from any other species. Thomas (1889, p. 193, footnote) remarked that the skull was scarcely distinguishable from that of *L. sumatrana,* and Trouessart (1897, p. 284) classified it as a variety of *L. sumatrana.* Pohle (1919, p. 41) placed it in the *Lutra sumatrana* group but considered that the skull showed much greater affinity with *L. intermedia,* Pohle than with *L. sumatrana,* Gray, though fully entitled to specific differentiation. Matthew (1929, p. 469) apparently agrees with the latter author, but has mentioned only those details of structure in which it differs from *Lutra lutra.*

The skull as a whole is relatively shorter than in *L. sumatrana*, but this is due to the shortness of the occiput, the facial region being relatively longer. The brain case is relatively wider than in *L. sumatrana*, but the facial region and in particular the muzzle and the palate are much narrower. The inter-temporal and inter-orbital breadths are identical. The post-orbital processes are rather more prominent than in *L. sumatrana.* Behind them the temporal borders remain approximately parallel for a distance of about 14 mm. Some specimens of *L. sumatrana* seem to resemble it closely in the latter feature, while in others the expansion towards the rear begins gradually almost immediately behind the orbits. In any case the marked contraction behind the post-orbital processes which is seen in *L. lutra* is entirely absent here.

There are certain differences from *L. sumatrana* in regard to the structure of the teeth, some of which, as Matthew has suggested, are probably indicative of a more primitive stage. In P^4, the antero-posterior diameter of the inner side is relatively less and the metacone is slightly longer. The protocone is differentiated as a distinct cusp from the remainder of the encircling rim, which is not the case in *L. sumatrana*, and in the fossil species the inner portion of the tooth is less hollowed. The parastyle is more distinct. In M^1 the transverse diameter is relatively greater and both the anterior and posterior sides slope backward considerably more; the metacone is more reduced; the line between it and the paracone is much more oblique. The canines are situated more to the inside than in *L. sumatrana*, although their size is at least equal to those of the living species. The diastema between the canine and I^3 is considerably less than in *L. sumatrana.*

The referred mandibular ramus is more slender than in *L. sumatrana*; the trigonid of M_1 is distinctly longer relatively to the talonid; the hypoconid is higher and more trenchant, on which account as also because the entoconid ridge is narrower and lower, the talonid is less basin-shaped than in either *L. sumatrana* or *L. nair.*

As Lydekker (1884, p. 193) has pointed out, this species bears no affinity to *Sivaonyx bathygnathus.* He was only acquainted with the ramus, but the P^4 referred to that species distinguishes it even more effectively. *L. hasnoti* seems equally to stand in no close relation to the Upper Siwalik species, on account of the narrow talonid and low metaconid of its M_1. *L.* (?) *furtiva* is very incompletely known, but its short M_1 and long premolar series indicate the entire absence of any close affinity either to this or any other Lutrine species. I know of no species, from which its descent might be immediately traced. One of the *L. sumatrana* group of otters might very well be its successor.

LUTRINE genus indet, HASNOTI, Pilgrim.

(Pl. II, figs. 18, 18*a*, 18*b*.)

1913. *Potamotherium* (?) *hasnoti*, Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, pp. 282, 291.

Diagnosis.—Lutrinae with stoutly built mandible, deeper than the length of M_1; M_1 broadest in the middle, tapering anteriorly; with talonid only two thirds the length of the trigonid and much narrower; protoconid extremely high; paraconid much lower, lying about as much to the inside as in *Lutra*; metaconid lower than paraconid, situated on the same level as the protoconid and partially connected to it by a transverse ridge; talonid not basin-shaped, with a low crenulated somewhat trenchant hypoconid; entoconid rim not markedly developed except at the extreme postero-internal corner; P_4 rather elongate, more than two-thirds the length of M_1, with a high main cusp, a rudimentary anterior cusp, a distinct posterior cusp and a strong posterior cingulum particularly promiment at the postero-internal corner.

Holotype.—The right mandibular ramus containing P_4 and M_1 figured in Pl. ii, figs. 18, 18a, 18b of the present work. It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 135.

Locality.—Hasnot, Salt Range.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description and comparisons.—The measurements of the holotype are tabulated on page 60. The relatively great breadth of the trigonid of M_1, and the stoutness of all the cusps, as well as their arrangement and in particular the advanced position of the metaconid, which is exactly on the same level as the protoconid, and the somewhat trenchant character of the hypoconid united with the lowness of the cusps which represent the entoconid, would seem to indicate that the specimen is Lutrine. On the other hand the height of the protoconid and the lowness of the metaconid are not characters which any modern Lutrines possess. If the cusps were more slightly built, the metaconid more backward and the hypoconid less trenchant some of the other features mentioned might invite a comparison with the Viverridae. In addition to the objections referred to, I know of no Viverridae in which the mandible is so deep and robust, while the latter character is typically Lutrine and the former is found in the Lutrine genera *Sivaonyx*, *Aonyx* and *Enhydriodon.* Each of the three latter genera, however, has the metaconid as high as the protoconid, and the talonid is much broader and basin-shaped. Further in P_4 the position of the posterior accessory cusp is quite different, lying to the outside of the main cusp, while in the present species it is directly behind it.

Viewed as a Lutrine many of the characters of the holotype are, however, primitive, as may be seen by a comparison with the Aquitanian genus *Potamotherium.* Such are the inferior length of M_1 relatively to P_4; the shorter metaconid; the narrower and shorter talonid; the position of the posterior accessory cusp of P_4 directly behind the main cusp; and the presence of an anterior accessory cusp in P_4. It is true that *Potamotherium valetoni* is not only much inferior in size to the present species, but the trigonid of M_1 is narrower, its cusps are lower, the hypoconid is more trenchant, and P_4 lacks the broad cingulum at the postero-internal corner of that tooth in the holotype, while in addition the mandible is slender and shallow. Neither of the American species referred to the genus *Potamotherium* are in any closer agreement with the present species. *P. robustum,* Cope is a smaller species, and the blade of the talonid is more cutting. *P. lycopotamica,* Cope is an extremely small species, but seems to agree with the present form in the structure of the premolars. In *P. lacota* Matthew and Gidley, which is an absolutely larger animal, the jaw is as deep as in the Indian species and would seem to be rather stout. On the other hand the teeth are more slender. P_3, apparently, has not the intermediate cusp behind the summit although its posterior cingulum is broad. The crown of P_4 is too broken to admit of a comparison.

It is not therefore feasible to classify *L.* (?) *hasnoti* with *Potamotherium,* as I was at first inclined to do. It is likely that it should be separated generically from all known species. I cannot point to any living otter of which it might reasonably be considered as ancestral, but until the meagre material which alone is at my disposal at present is somewhat augmented, I refrain from giving the species a generic name.

LUTRINE genus indet. FURTIVUS, sp. nov.

(Pl. III, fig. 11.)

Diagnosis.—Lutrinæ of small size; with rather stoutly built mandible, deeper than the length of M_1; with deep masseteric fossa; a large mental foramen beneath P_2 and another between P_3 and P_4; M_1 extremely short only one quarter as long again as P_4, with its greatest breadth in the middle; three cusps of trigonid of approximately equal height, close together; paraconid considerably shifted to the inside; talonid short, length about three quarters that of the trigonid and slightly narrower, with trenchant hypoconid; entoconid probably low; M_2 small, sub-circular; premolar series very long; P_4 slightly broader behind, with posterior accessory cusp and strong posterior cingulum; P_2 and P_3 double-rooted, lying obliquely to the axis of the jaw; P_1 single-rooted lying internally to the anterior root of P_2.

Holotype.—The right mandibular ramus figured in Pl. iii, figs. 11, 11a of the present work. It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 239.

Locality.—Malian Dhok, near Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The holotype is a poorly preserved right mandibular ramus, showing the entire depth beneath P_4 and immediately behind M_2 but with the lower border broken between these points. A portion of the masseteric fossa is preserved but the coronoid process, the condyle and the angle are lacking. M_2 is only known by its root; and the crowns of M_1 and of all the premolars are considerably weathered or broken. The ramus is stoutly built and deeper relatively to its length than in any of the otters except *Aonyx*, *Sivaonyx* and *Enhydriodon.* The general shape and structure of M_1 can be made out, although the front of the paraconid and the inner side of both paraconid and metaconid are broken away and the end of the talonid is missing. Its length is decidedly less than in any of the living otters proportionately to the length and depth of the jaw and to the length of the premolar series. It is only one quarter as long again as P_4. Even in *Potamotherium* M_1 is not as short as this. The hree cusps of the trigonid are of equal height; all lie close together and the metaconid is on a level with the protoconid; the paraconid appears to lie rather inside the median axis of the tooth. The talonid is slightly narrower than the trigonid; it is obviously shorter than in living otters and is about three quarters of the length of the trigonid. It appears to have had a trenchant hypoconid of which the exact height cannot be determined on account of weathering, nor can the height of the entoconid be observed for the same reason. The premolar series is considerably longer than in any of the living otters, making some approach in this respect to *Potamotherium.* P_4 is slightly broader behind than in front; it had evidently an accessory cusp which lay directly behind the main cusp, though the summits of both have been broken away. There was also a strong posterior cingulum. The structure of P_2 and P_3 cannot be made out. They were smaller than P_4 and lay obliquely in the jaw. P_1 is only known by a piece of the root, which lies inside the anterior root of P_2 and close against the inner side of what seems to be the extreme end of the alveolus of the canine. The rest of the canine alveolus and everything in front of it is missing. The measurements of the specimen are included in the table on page 60.

Comparisons.—From the shape of the lower border of the ramus and from the size and depth of the masseteric fossa, as well as by the structure of the trigonid of M_1, I think that the specimen must be Lutrine. It is certainly more primitive than any living otter or than *L. palæindica,* as shown by the premolar series being unreduced and very long and by the short M_1 with a talonid which is much shorter than the trigonid. It is, however, difficult to suggest one of the otter lines rather than another to which it might belong, more especially in view of its poor state of preservation. The deep ramus is like that of *Aonyx,* but from that genus as well as from *Sivaonyx* it is distinguished by the narrower talonid of M_1 and its apparently different structure. The shortness of M_1 seems to indicate that it cannot be connected with any species of *Potamotherium.* As we are unacquainted with the fossil history of *Aonyx* we cannot definitely deny that this species may be a primitive stage of that genus. In the circumstances I cannot venture to give it a generic name.

INCERTÆ SEDIS.

Genus: SIVALICTIS, nov.

Genotype.—Sivalictis natans, sp. nov.

SIVALICTIS NATANS, sp. nov.

(Pl. I, fig. 1.)

Diagnosis.—A Carnivore of large size, with an M^1 of Mustelid shape and structure; with the three roots very strong and massive and entirely fused to one another; outline sub-triangular; with all the corners rounded; antero-posterior about two thirds of the transverse diameter; outer border very oblique; all the cusps extremely low and bunodont, surface of crown concave transversely; paracone strong with strongly serrated outer edge; metacone weaker; protocone separated by a hollow from the two outer cusps; a very strong parastyle represented by a broad antero-external shelf; a broad postero-internal cingular shelf situated at a different level from the internal cingulum; a slight anterior cingulum.

Holotype.—The isolated tooth figured in Pl. i, figs. 1, 1a, 1b of the present work. It is in the collection of the Geological Survey of India regd. no. D 227.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The holotype is apparently a right upper molar, probably M^1, of a Carnivore. Its outline may be called sub-triangular, but the corners of the triangle are rounded to such an extent that it is actually irregularly ovate. All the cusps are low, and this lowness is real and not the effect of wear or weathering. The three main cusps which are present in the upper molars of most of the Canids, Viverrids and Mustelids can be recognized and their position, as I interpret them, is indicated by the letters on fig. 1b. The surface of the tooth is transversely concave and is thus similar to that of the ordinary Viverrid or Canid upper molar. The paracone is represented by a semicircular ring with outwardly radiating ribs, which may have been accentuated by weathering; inside of this ring is a hollow, also possibly accentuated by weathering. The metacone is represented by a small circle of wear. The protocone presumably is to be seen in the low semicircular ridge which bounds the central hollow internally; weathering has possibly reduced the height of this. The line joining the paracone and metacone is oblique to the short diameter of the tooth. A strong cingular shelf, which appears to represent the parastyle, exists on the outer side of the paracone, but is absent outside the metacone. A cingulum also exists on the posterior margin and a narrow one on the anterior margin. The flattened portion of the crown internal to the central hollow is in direct continuation of the anterior cingulum and is reminiscent of the strong internal cingulum characteristic of the Mustelidae. A step down is taken, however, before we reach the posterior cingulum, which does not conform with the structure of any Mustelid M_1 which I have seen. The roots are completely fused but the former existence of the usual three roots of the Viverrid and Mustelid upper molar is clearly shown by the traces of the division between them; they are strong and massive. Its dimensions will be found on page 60.

Remarks.—The size of this tooth suggests that it may be Canid, but the obliquity of the line joining the paracone and metacone and still more the presence of the strong antero-external cingulum at once negatives this suggestion. Both the great size of the tooth and the low cusps militate against associating it with the Viverridae, in which family no evolutionary specialisation of a similar character has as yet been proved to exist. On the other hand the increase in size of the upper molar is a phenomenon which is characteristic of many phyla of the Mustelidae during the Pontian epoch, while the flattening of the cusps in response to a change in diet can equally be paralleled in *Latax* (=*Enhydra*), although it has proceeded much farther in the genus named. If one compares our specimen feature by feature with M^1 of *Potamotherium*, assumed to be near the ancestral type of the otters, the same elements can be observed, although their grotesque development in order to serve a different purpose has altered their appearance out of almost all recognition.

The above interpretation of the peculiar structure of the tooth before us may prove to be altogether incorrect, but at any rate parallels to it actually exist, and I cannot devise a reasonable alternative. Its verification must await the discoveries of further material and perhaps cannot be fully proved until the entire skull is known. In any case the unique character of the specimen renders it certain that it is generically different from the upper molar of any genus which has hitherto been described. Under these circumstances I consider it advisable to facilitate the work of reference by giving it the new generic name of *Sivalictis*, the specific designation *natans* being given to it in allusion to the possibility that it was a Lutrine animal of aquatic habits in which a peculiar dentition has been developed due to the adoption of a hard diet, corresponding to that which has taken place in *Latax* (=*Enhydra*) *marina.*

There are two other specimens described below (G. S. I. nos. D 128 and 207): one an isolated P^4 from Chinji; and the other the front portion of a maxilla from the Dhok Pathan stage of Hasnot, which agree in size with the present M^1 and show some indications of an unusual Lutrine structure. No more can be said except that there is a possibility that they may belong to the same or an allied form to *Sivalictis natans.*

INCERTÆ SEDIS.

Genus indet., species indet.

(Pl. I, fig. 5.)

From the same locality and horizon as the holotype of *Sivalictis natans* comes an isolated left P^4 (G. S. I. no. D 128) figured in Pl. i, figs. 5, 5 a-c, of the present work, which is placed here more for convenience than because there is any real evidence that it belonged to the same genus or even the same family as the upper molar of *Sivalictis natans.* Its size is such as might correspond with that specimen. Its roots are strong and fused near the base of the crown to an unusual extent, but beyond this there is no reason to regard it as generically the same. The summit of the paracone has been obliquely eroded by wear producing a flat surface sloping steeply down almost to the parastyle. The posterior part of this plane of erosion has been broken off and with it the greater part of the blade which constitutes the metacone. A low but distinct parastyle exists. The protocone forms a prominent shelf bounded on its inner side by a low rounded, inconspicuous border. This protoconal shelf starts opposite the extreme anterior point of the tooth and is continued back, but with a gradually diminishing width, for a distance more than half the total length of the tooth. It then passes into a strong cingulum of which the end cannot be seen on account of the break in the hinder end of the crown of the tooth. A cingulum also exists on the external margin of the tooth.

I have seen in no member of the Amphicyoninæ a protocone which extends so far back as in the present tooth. Many of the Cynodontinae and the Ursidae have an equally long protocone, but in no case does it start so far forward as here, except in the specimen from the Bugti Hills figured by Cooper (1923, p. 262) under the name of *Cephalogale bugtiensis*, which, I have doubtfully referred (*see* above, page 29) to the aberrant genus *Metarctos*. The Bugti tooth has no parastyle and the protocone forms less of a flat shelf than is the case here. I think that the nearest parallel is to be found in P^4 of some of the early Lutridæ such as *Potamotherium lorteti*. The figure of *Potamotherium oppoliensis* given by Wegner (1913, p. 230) seems to afford somewhat of a parallel. In them, however, the protocone is more basin-shaped and its internal margin is more rounded. It is conceivable that it might belong to the M^1 which has been described above, but farther than this one cannot go. Like the preceding specimen it belongs to a unique type and I cannot find a satisfactory parallel amongst previously described material. In default of such a parallel I have somewhat arbitrarily described the two Chinji specimens successively. The dimensions of both are included with those of the Mustelidae on page 60.

INCERTÆ SEDIS.

GENUS indet., species indet.

(Pl. I, fig. 7.)

From the Dhok Pathan stage of Hasnot comes a fragment of the right maxilla containing the canine, two premolars and the beginning of the alveoli of two roots standing abreast which can only be those of P^4 (G. S. I. no. D 207), figured in Pl. i, figs. 7, 7a. The canine is an extraordinarily large tooth with an elongate oval cross section without any sign of longitudinal keels, slightly procumbent, with a comparatively short root, much dilated at its junction with the crown. Both the premolars are too greatly weathered to show the structure quite clearly; P^1 is absent; P^2 has a circular crown due to the presence of a marked internal cingulum and an external expansion. The summit shows an antero-posteriorly elongated zone of wear and much weathered anterior and posterior keels. The crown is implanted on a single stout root. A short diastema exists between P^2 and the canine and a much longer one between P^2 and P^3. P^3 is an elongate oval tooth, apparently slightly broader in front than behind, with an internal cingulum which possibly extends round the crown, though the weathering is too great to enable it to be distinguished clearly. The crown slopes steeply from the summit to the anterior margin, where there is no accessory cusp. The posterior slope is more gradual and there is a distinct posterior cusp. The crown is implanted on two stout roots, which are close together though not actually fused. Lying posteriorly to P^3 are two alveoli, of which one is directly behind P^3 while the other lies considerably internal to but abreast of the former. These must represent the alveoli of the roots of the paracone and protocone of P^4. The fracture of the maxilla does not permit one to see either the border of the orbit or the infraorbital foramen. The incisor region is entirely missing.

The great size of the canine, and the simple cingulated crowns of the premolars seem to indicate that the maxilla belongs to a Mustelid. The excessive dimensions of the canine, the shape of its root and the reduced premolar series with a one-rooted P^2 invites a comparison with *Enhydriodon sivalensis.* A similar large, rather procumbent canine and a reduced number of premolars is seen in *Lutra aonychoides,* Zdansky. In the Chinese species, however, P^2 has two roots. The specimen before us is clearly different from *Enhydriodon* not only on account of the slenderer P^3, of which the greatest diameter lies in the front instead of the rear of the tooth, but still more because the alveoli of P^4 indicate that the internal expansion of that tooth was very much less than in *Enhydriodon.*

I am inclined to think that the maxilla belongs to an animal of Lutrine lineage which had specialised earlier than *Enhydriodon,* but along somewhat similar lines and in response to a similar change of diet from softer to harder material. It has, however, obviously remained closer to *Potamotherium.* These are precisely the genetic indications afforded by the M^1 and P^4 described above (pages 77, 79) under the name of *Sivalictis natans* and gen. indet. sp. indet. and for this reason I have chosen this place for the description of the specimen. Obviously the P^4 described above is too large for the alveoli of which traces are visible in the maxilla, but a similarly constituted tooth of smaller dimensions would quite easily fit the alveoli in question. I need hardly say that being fully conscious that neither of the specimens is sufficient for generic diagnosis, and there being no evidence of association, I do not claim more than a possibility that there may be a generic affinity between them. Since, however, they are all of them peculiar specimens, they are in their way of some importance and subsequent reference to them will probably be facilitated by classifying them together in this work.

Genus : ENHYDRIODON, Falconer.

1835. *Amyxodon nom. nud.,* Falconer and Cautley, *Journ. As. Soc. Beng.,* IV, p. 707.
1868. *Enhydriodon,* Falconer, Pal. Mem., I, p. 331, Pl. xxvii, figs. 1-5.

Diagnosis.—Lutrinae of extremely large size; brain-case rather swollen and high; temporal region considerably contracted and continuing so for a long distance with approximately parallel side walls; orbits of moderate size; infra-orbital foramina large; post-orbital processes rather prominent; muzzle rather broad, very short; with large nasal opening, broader than high; lambdoidal crest rather prominent; auditory bulla rather prominent and very broad; external auditory meatus situated opposite the posterior part of the bulla; dentition differing from other genera mainly by the structure of P^4 in which the inner half of the tooth consists of two cusps (protocone and hypocone), of which the former may be still further divided; well marked paracone and metacone and a progressively strengthening parastyle; M^1 large, especially in regard to its transverse diameter, which exceeds its antero-posterior diameter; canine and I^3 very strongly developed; I^1 with a progressive tendency to disappear; P^1 and probably P_1 absent; P^2 also with a tendency to disappear in the most advanced species (*E. sivalensis* Falc.); M_1 as in the genus *Aonyx* but with the cusps of the trigonid well separated, talonid basin-shaped surrounded by a ring of low cusps; P_4 short, broadening posteriorry, with a strong postero-external cusp and a broad singulum.

Genotype.—Enhydriodon sivalensis, Falconer (1868, p. 331, Pl. xxvii, figs. 1-5).

Species.—In addition to the genotype *E. sivalensis*, another smaller species from the Siwalik Hills was mentioned by Falconer (Pal. Mem., I, p. 336) without either name or figure. Matthew (1929, p. 472) has pointed out the probability that a specimen of P^4 in the British Museum (No. M 4847) not previously figured is the one which Falconer had in mind. He figured it but equally omitted to give it a specific name. Later I gave the name *Enhydriodon falconeri* to this specimen and refigured it (Pilgrim 1931, p. 56, Pl. ii, figs. 3, 3a). Its history so far as we know it is related below (page 86) and a specific diagnosis and description is given. *Enhydriodon campanii* (Meneghini 1862, p. 18), from the beds of Monte Bamboli in Tuscany is for the present regarded as a third species. Stromer (1931, p. 18, Pl. i, figs. 3, 4) has founded the species *E. africanus* on an M^1 and a mandibular ramus from S. W. Africa in a deposit supposed to belong to the 'Middle' Pliocene. Finally an associated front and hind foot from Pikermi have been referred provisionally to the genus *Enhydriodon* (Pilgrim 1931, p. 56) on account of their Lutrine affinities and their large size, under the name of *Enhydriodon* (?) *latipes*.

Remarks.--The history of the name of this genus has been dealt with by Lydekker (1884, p. 195) and brought up to date by Pohle (1919, p. 156). Both these authors discussed its affinities and the justification for separating it generically from *Lutra*. The same questions have more recently been dealt with by Matthew (1929, p. 471) and myself (Pilgrim 1931, p. 55).

Lydekker fully recognized the affinities of the two species *E. sivalensis* and *E. campanii*, but considered that neither of them could be generically differentiated from *Lutra*. Weithofer (1889, p. 57) revived the name *Enhydriodon*, in which he was followed by Trouessart (1897, p. 282) and Pohle (1919, p. 156). Neither of these authors doubted its Lutrine affinities. Matthew (1929, p. 471-2) considered that *E. campanii* was entitled to generic distinction from *E. sivalensis*, because of the less quadrate shape of P^4; the more anterior position of the protocone; the more elongated and crested shape of the hypocone; the absence of the twinning of the protocone in M^1; and the fully functional character of P^2 as opposed to its vestigial nature in *E. sivalensis*. He also remarked 'Neither probably has anything to do with the otters; they are separately descended from some primitive type allied perhaps to *Megalictis* and other Lower Miocene genera—*not* to *Potamotherium*, which is the ancestral type for otters.'

I agree with Matthew that *E. campanii* is decidedly more primitive than *E. sivalensis* and that when we know more about it, it will probably be necessary, to make it into a separate genus. Since, however, the characters he mentions seem to be subject to some variation in the Indian forms, and since both of them differ in much the same way by their more bunodont cusps from the two new fossil genera *Sivaonyx* and *Vishnuonyx* from India, which I have felt bound to establish on very imperfect material, although their approximate ancestry to *Enhydriodon* is very probable, I do not feel called upon to add another generic name to the nomenclature.

If the foot bones which I described (Pilgrim, 1931, p. 56) under the name of *Enhydriodon* (?) *latipes* are really those of a species of *Enhydriodon*, as their size would indicate, then the Lutrine affinities of *Enhydriodon* cannot be doubted. They show little resemblance to *Meles*, but more to *Martes* and *Gulo*, at any rate in regard to the retention of what appear to be primitive Mustelid characters. As I have stated (Pilgrim 1931, p. 72) these primitive survivals seem to indicate that *Enhydriodon* is descended from a form which was at any rate contemporary with *Potamotherium* so that the *Enhydriodon* and *Potamotherium* branches are distinct. In this Matthew's views and my own coincide. At the same time the affinities between the three genera *Enhydriodon*, *Sivaonyx* and *Aonyx*, incline me to think that the latter modern genus may be distinct from the line which led from *Potamotherium* to most of the other living otters. This, however, is no reason for disregarding the distinctly aquatic modifications which *Enhydriodon* equally with *Aonyx* shows, and their position in the Lutrinæ seems unassailable on the facts which are at present before us, assuming that they are really facts and not an illusory series of coincidences.

ENHYDRIODON SIVALENSIS, Falconer.

1835. *Amyxodon* sp. *nom. nud.*, Falconer and Cautley, *Journ. As. Soc. Beng.*, IV, p. 707.
1839. *Amyxodon* sp. *nom. nud.*, Royle, Illustr. Bot. Himal., I, p. 31.
1868. *Enhydriodon ferox* MS name, description of unpublished plate P. figs. 4-6 in Fauna Antiqua Sivalensis, Falconer, Pal. Mem., I, p. 552.
1868. *Enhydriodon sivalensis*, Falconer, Pal. Mem., I, p. 331, Pl. xxvii, figs. 1-5.
1884. *Lutra sivalensis* (Falconer), Lydekker, *Pal. Ind.* (10), II, p. 195, p. 198, text-fig. 3, p. 351; Pl. xxvii, fig. 5, Pl. xlv, figs. 3, 3a.

Diagnosis.—An *Enhydriodon* of large size; with upper cheek teeth series shorter than in *E. campanii;* P^3 broader posteriorly than in *E. campanii;* P^2 absent or small; P^4 with transverse distinctly greater than antero-posterior diameter; protocone situated more backward and internally than in *E. campanii;* hypocone no larger than protocone, subconical; M^1 with protocone often twinned and with occasional accessory cusps at the hinder end of the tooth.

Lectotype.—Of the three skull fragments described and figured by Falconer (1868, I, p. 331, Pl. xxvii, figs. 1-5), which are in the British Museum regd. nos. 37153, 37154, 37155, Matthew (1929, p. 471) selected the most complete, no. 37153 to be the holotype.

Referred specimens.—A specimen of the facial portion of the skull in the Museum of the Royal College of Surgeons, London, collected in the Siwalik Hills and presented by the Rev. R. Everest. This has been described and figured by Lydekker (1884, p. 196, Pl. xxvii, fig. 5).

A fragmentary right mandibular ramus in the Ipswich Museum, collected in the Siwalik Hills by Sir P. T. Cautley. This was described and figured by Lydekker (1884, p. 351, Pl. xlv, figs. 3, 3a).

Locality.—All the specimens are from the Siwalik Hills, but their precise locality is unknown.

Horizon.—This is certainly Upper Siwalik, but whether it belongs to the Pinjor or to an older stage from which it seems likely that some of Falconer's and Cautley's specimens were obtained is uncertain.

Remarks.—Little need be added to Falconer's and Lydekker's description of this species, or to the later comments by Pohle (1919, p. 155), Matthew (1929, p. 471) and Pilgrim (1931, p. 55). Pohle has stated that it is most closely allied to the genus *Aonyx* among living otters. This is most clearly seen in the high, swollen brain case and the great distance over which the contracted portion of the temporal region continues. If, as seems very likely, the referred mandible in the Ipswich museum belongs to this species, then in addition both *Aonyx* and *Enhydriodon* are characterised by a deep ramus and a broad, basin-shaped talonid in M_1. The Ipswich mandible is too fragmentary and worn for accurate description, but its depth and the broad and basin-shaped talonid of M_1 is reminiscent of that of *Aonyx* and *Sivaonyx bathygnathus* and equally of the M_1 from Hasnot (G. S. I. no. D 161) referred to *Enhydriodon falconeri* (*see* page 85). It is so extremely probable that the last named specimen represents essentially the structure of that tooth in the genus *Enhydriodon* as a whole, that we may conclude that its resemblance to M_1 of *Aonyx* as opposed to the corresponding tooth of most other living otters affords yet another feature of likeness between the two genera.

The most important difference from *Aonyx* lies in the structure of P^4, which on its inner side shows two strongly developed conical cusps, the protocone and hypocone, while on the outer side there is a parastyle and an extremely robust paracone and metacone. In *Aonyx* a hypocone is absent, the protocone is more median and much more slender; the outer cusps are trenchant rather than conical and the parastyle is weaker.

Matthew (1929, p. 472) has suggested that *Lutra aonychoides*, Zdansky (1924, p. 45) of the Pontian of China 'is in some respects the form from which *Enhydriodon* might be derived'. Zdansky merely says: '*Lutra sivalensis* ist ebenso wie *L. campani* in der Richtung gegen *Enhydra* zu spezialisiert kommt daher hier nicht weiter in Betracht'. I do not think that there is any very close affinity between *Enhydriodon* and *Latax* (=*Enhydra*). Pohle (1919, pp. 155, 159) has emphasised the strong difference between the latter genus and all other Lutrine genera. On the other hand he has remarked on the resemblances between *Enhydriodon* and *Aonyx.* Matthew's suggestion is interesting but at the same time from an examination of a cast of the P^4 of *Lutra aonychoides*, which Dr. Zdansky was kind enough to send me, I find that 'the appearance of a semi-separate cingular cusp which might develop into the hypocone of *Enhydriodon'* is much less than the figure has suggested to him. It is hardly more than the faintest swelling and I do not think that Zdansky's species can be generically separated from *Aonyx* (*see* below p. 92).

A much closer parallel is to be found in the P^4 of *Sivaonyx bathygnathus* (Lydekker), in which a real hypocone exists, also a strong parastyle, while the outline is similar, the important difference being that the cusps are smaller and more trenchant, thus approaching *Aonyx* more than *Enhydriodon.* I conceive *Aonyx* to be the modern survival of a form more primitive than either *Sivaonyx* or *Enhydriodon,* though it has suffered a reduction of the metacone, which is somewhat elongated even in the Dhok Pathan *Sivaonyx* and still more so in the Chinji *Vishnuonyx.* On this hypothesis *Aonyx* is the representative of a branch distinct both from *Sivaonyx* and *Enhydriodon* as well as from *Potamotherium* and *Lutra.* '*Lutra aonychoides*' may be a species of *Aonyx* which had varied in the faintest degree in the direction of *Sivaonyx.*

The differences of *E. sivalensis* from *E. campanii,* which Matthew has emphasised and which he considers are of generic value, are embodied in the diagnosis of *E. sivalensis,* and are commented on above (page 82). It is certainly more primitive than *E. sivalensis* and approaches *Sivaonyx* in the smaller transverse diameter and more anterior position of the protocone of P^4 and in its less reduced premolar series, but it is not proposed here to adopt Matthew's suggestion and erect another genus for its reception.

ENHYDRIODON FALCONERI, Pilgrim.

(Pl. II, fig. 15.)

1868. *Enhydriodon* sp., Falconer Pal. Mem., I, p. 336.

1929. *Enhydriodon* sp., Matthew, *Bull. Amer. Mus. Nat. Hist.*, LVI, p. 472, text fig. 11.

1931. *Enhydriodon falconeri,* Pilgrim, Br. Mus. Catalogue of the Pontian Carnivora of Europe, page 56, Pl. ii, figs. 3, 3a, 5, 5a, 5b.

Diagnosis.—An *Enhydriodon* of smaller size than *E. sivalensis;* P^4 with transverse only slightly greater than antero-posterior diameter, with protocone twinned and slightly more anterior than in *E. sivalensis;* paracone and metacone somewhat less bunodont; with a stronger parastyle.

Holotype.—The isolated P^4 figured by Matthew (1929, p. 472, text fig. 11) and by Pilgrim (1931, Pl. ii, figs. 3, 3a). It is in the British Museum regd. no. M 4847.

Referred specimen.—The isolated specimen of M_1 collected by Vinayak Rao in the neighbourhood of Hasnot, Salt Range (G. S. I. no. D 161), which was mentioned by Pilgrim (1913, p. 282) under the name of *Enhydriodon* sp. aff. *sivalensis,* figured (1931, P. 54, pl. ii, figs. 5, 5a, 5b) and refigured in Pl. ii, figs. 15, 15a, 15b, of the present work, is referred with considerably uncertainty to this species.

Locality.—The type locality is the Siwalik Hills. The doubtfully referred M_1 came from the neighbourhood of Hasnot, Salt Range.

Horizon.—The somewhat more primitive character of the holotype invites the idea that it might belong to a lower level than that of *E. sivalensis,* but it is in the highest degree improbable that it is Middle Siwalik, as Matthew (1929, p. 472) has suggested. Not only do the stratigraphical relations of the various beds in the Siwalik Hills militate against any deposit there being as early as the Dhok Pathan stage, but amongst the fossils collected by Falconer, Cautley and their co-workers, none of the typical species of the Dhok Pathan stage occur, with the doubtful exception of *Hipparion antelopinum* which Matthew has suggested may be identical with *Hipparion punjabiense.* There is, however, a very distinct possibility that the lowest beds exposed in the Siwalik Hills may correspond to the Tatrot stage of the Salt Range, and that some of Falconer's species, which are the same or closely allied to species which belong to the stage mentioned, may have been collected in these lowest beds. The matter is discussed on pages 2, 3 above but there is no definite proof one way or the other.

With regard to the M_1 (G. S. I. no. D 161) from Hasnot, we cannot altogether exclude the possibility that a villager, who perhaps brought the specimen to Vinayak Rao, may have collected it from the Tatrot stage, or it may have been among the fossils washed down from the overhanging cliffs of that stage into Middle Siwalik ground. Since, however, the genus occurs in Europe in undoubted Pontian or even pre-Pontian deposits, there is no reason why the specimen should not be really Middle Siwalik.

History of the holotype.—Falconer (1868, p. 336) mentioned the existence of a P^4, from the Siwalik Hills which he considered to belong to a second species of *Enhydriodon.* This was not figured at that time, and appears to have been mislaid even at the period when the Palæontological Memoirs were published. It was unknown to Lydekker when he wrote his accounts of Indian Carnivora in 1884 and 1885, and appears not to have been found until early in this century, when Forsyth Major had it drawn for a prospective paper, which was never written. The drawing is still in existence and was reproduced in a recent work by myself (Pilgrim, 1931, Pl. ii, figs. 3, 3a). The P^4 (Br. Mus. no. M 4847) is almost certainly the missing specimen, as Matthew opines. It was figured by the latter author (1929, p. 472, text fig. 11) with only a brief mention.

Description and comparisons.—The holotype is smaller than the P^4 in the two specimens of *E. sivalensis* which have the outline of the tooth perfectly preserved, as will be seen from the following measurements.

	Coll. Surgeons no. 777A.	Br. Mus. no. 37153.	Br. Mus. no. M 4847.
Antero-posterior diameter .	17·6	15·4	14·8
Transverse diameter .	19·4	17·2	15·9

The excess of the transverse over the antero-posterior diameter is certainly less than in the case of *E. sivalensis,* and approaches the condition which is found in *E. campanii* and in *Sivaonyx bathygnathus.* The central valleys are just as much blocked by the stoutness of the cusps, but the bunodonty is less pronounced in the case of the paracone and metacone than in *E. sivalensis.* The protocone is cleft into two parts, while the median cingular cusp between the protocone and hypocone is weaker than in the specimens figured by Falconer (1868, Pl. xxvii, fig. 2) and Lydekker (1884, Pl. xxvii, fig. 5). This median cusp is absent in *E. campanii* and only slightly indicated in *Sivaonyx bathygnathus.* It appears, however, that there was some variation with regard to it, because in Br. Mus. no. 37153 figured by Falconer in Pl. xxvii, fig. 4 either the median cusp was absent or else it was closely united to the protocone; it is impossible to say which, on account of the fracture of the front portion of the tooth. The parastyle seems to be rather stronger than in *E. sivalensis.*

The doubtfully referred M_1 from Hasnot (G. S. I. no. D 161) may not have been any shorter than the corresponding tooth in the Ipswich mandible of *E. sivalensis;* but at any rate the width of the talonid is very decidedly less. Even so the breadth and stoutness of the tooth distinguishes it from M_1 in every known species except *Aonyx capensis, Lutra reevi,* Newton, *Sivaonyx bathygnathus* and *Sivaonyx hessicus.* The proportionate lengths of the talonid and the trigonid seem to be very much what is the case in the Ipswich mandible and to conform approximately to what we find in most of the genera of otters. This is, however, not the case in *Aonyx capensis,* in which the talonid is exceptionally long compared to the trigonid. In this respect *Sivaonyx bathygnathus* agrees with *Enhydriodon.* The three cusps of the trigonid are of approximately the same height, but the metaconid is less robust than the other two. The paraconid does not lie so much to the inside of the median line which passes midway between the protoconid and the metaconid, and in consequence the tooth is much more symmetrical than in *Aonyx.* This character equally distinguishes the M_1 of *Sivaonyx bathygnathus* and *Sivaonyx hessicus,* Lydekker (*see* Pilgrim, 1931, p. 76). Partly owing to the backward position of the metaconid and partly to the flat surfaces of the three cusps against the area which they enclose, there is a wide valley between the paraconid and the metaconid and a broad almost flat area is enclosed between the three cusps. This makes the tooth especially unlike M_1 of *Aonyx capensis,* but in a lesser degree distinguishes it from that of every other species of otter which I have studied. The cusps of the talonid are worn, but it is obvious that they form a semicircular wall which encloses a hollow. The external ridge which bounds the hollow has very little of the height and cutting power which is characteristic of it in *Potamotherium.* On the other hand this is a feature of the genera *Aonyx* and *Paraonyx.* The internal wall which bounds the hollow is differentiated into three or perhaps more low cusps. The tooth is bounded on all sides except the postero-internal half by a basal cingulum. A similar, but broader M_1 from the Middle Pliocene of Egypt was described by Stromer (1920, p. 363, fig. 11). That of *E. africanus* is even closer.

It will thus be seen that in respect of the structure of its M_1 *Enhydriodon* cf. *falconeri* closely resembles *Sivaonyx.* In fact except by its larger size and the relatively slightly broader talonid it does not seem that the genera can be separated on the characters of M_1 alone. The talonid of *Enhydriodon sivalensis* seems to have been as much broader than that of the Hasnot M_1 as the latter is than *Sivaonyx bathygnathus*, so that the character is probably a progressive one. In a less degree the Hasnot tooth resembles the M_1 of the living genus *Aonyx*. The latter is distinguished, as mentioned above, by the relatively longer trigonid and the more asymmetrical position of the paraconid.

The dimensions of the tooth are as follows:—antero-posterior diam. 21·6 mm.; transverse diam. 12·7 mm.; length of trigonid 13·0 mm.; length of talonid 10 mm.

Genus: SIVAONYX, Pilgrim.

1931. *Sivaonyx*, Pilgrim, Br. Mus. Cat. Pontian Carniv. Eur., p. 74, Pl. ii, figs. 4, 4a.

Diagnosis.—Lutrinæ of large size; having a P^4 of an approximately quadrate shape with a moderately trenchant paracone-metacone blade; paracone somewhat stoutly built; metacone very slightly elongate; parastyle well developed but low; with two internal cusps, protocone and hypocone, lower than the outer cusps, somewhat stoutened and expanded so that the basin-shaped area is contracted; with a strong internal cingulum; mandible with ramus deeper than the length of M_1; canine large; P_1 single-rooted; P_4 broad posteriorly, with a strong, outwardly situated posterior cusp and a broad cingulum, no anterior accessory cusp; M_1 very broad; paraconid situated so as to be bisected by the median axis of the tooth; metaconid as high as paraconid; talonid broader than trigonid and approximately equal in length to it, basin-shaped, surrounded by a ring of cusps of which the entoconid is as well developed as the hypoconid; M_2 small, oval.

Genotype.—*Lutra bathygnathus*, Lydekker (1884, p. 193, Pl. xxvii, figs. 3, 4).

Species.—In addition to the genotype, I have included (Pilgrim, 1931, p. 76) the species *Lutra hessica*, Lydekker (1890, p. 3, text fig.), from the Pontian beds of Eppelsheim in this genus. Stromer (1920, p. 361, fig. 10) has described an M_1 from the Middle Pliocene beds of the Wadi Natron (Egypt) as *Lutra* aff. *hessica*.

SIVAONYX BATHYGNATHUS (Lydekker).

(Pl. II, figs. 14, 16; Pl. IV, fig. 1.)

1884. *Lutra bathygnathus*, Lydekker, *Pal. Ind.*, (10), II, p. 193, Pl. xxvii, figs. 3, 4.
1931. *Sivaonyx bathygnathus* (Lydekker), Pilgrim, Br. Mus. Cat. Pont. Carniv. Eur., p. 74, Pl. ii, figs. 4, 4a.

Diagnosis.—A *Sivaonyx* in which M_1 differs from that of *S. hessicus* by its slightly greater breadth, talonid slightly longer relative to the trigonid; P_4 with a broader posterior root; depth of ramus greater than instead of only equal to the length of M_1.

Holotype.—The left mandibular ramus described and figured by Lydekker (1884, p. 193, Pl. xxvii, fig. 3, 3a) under the name of *Lutra bathygnathus*. It is in the collection of the Geological Survey of India, regd. no. D 33.

Referred specimens.—Lydekker referred to the species a fragment of the left mandibular ramus (G. S. I. no. D 34) showing much more of the hinder portion than the holotype, and also the alveolus of M_2, but nothing of the teeth in front of it. This reference, doubted by Matthew (1929, p. 470), is probably confirmed by the additional specimens of the species mentioned below and unknown either to Lydekker or Matthew.

A left mandibular ramus (G. S. I. no. D 156) from the Dhok Pathan stage of Hasnot, figured in Pl. ii, fig. 14 of the present work.

The front portion of the right mandibular ramus (G. S. I. no. D 244) from the Dhok Pathan stage of Hasnot, figured in Pl. iv, figs. 1, 1a of the present work.

The hinder portion of the right mandibular ramus (G. S. I. no. D 250) also from the Dhok Pathan stage of Hasnot, containing M_1, of which only the talonid is preserved and the broken base of M_2.

A Sixth specimen (G. S. I. no. D 249) consisting of the hinder part of the left mandibular ramus with M_1 and the root of M_2 was collected by H. M. Lahiri about six furlongs S. S.W. of Kamlial, Salt Range, from a horizon which he regards as Dhok Pathan. This is smaller than the others and may be specifically different, but since the portions preserved show no differences in structure from the other specimens, one cannot regard the inferiority in size as due to more than individual variation.

Finally an isolated left P^4 (G. S. I. no. D 157), which was collected from the same horizon at Hasnot, shows a Lutrine structure approximating to that of P^4 of *Enhydriodon*, and corresponds in size to the holotype and referred rami of *Sivaonyx bathygnathus*. In the circumstances it is highly probable that I am right in attributing it to this species. It has been briefly described and figured in a previous work by myself (Pilgrim, 1931, p. 75, Pl. ii, figs. 4, 4a). The same drawing is again reproduced in Pl. ii, figs. 16, 16a of the present work.

The measurements of all these specimens are collected in the table on page **60**.

Locality.—The type locality is Hasnot, and with the exception of the ramus no. D. 249 all the referred specimens were collected in the same neighbourhood.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description.—As Lydekker (1884, p. 193) has stated, the depth of the ramus is considerable and much exceeds the length of M_1, both in the holotype and all the referred specimens, as may be seen from the measurements on page **60**. The masseteric fossa is very deep and extends forward to M_2. The shape of the hinder part of the ramus is Lutrine in character. There are three mental foramina running obliquely downward from P_2 to P_4.

M_1 is an exceedingly broad tooth, its broadest portion being situated in the anterior part of the talonid, from which point it tapers more towards the front than towards the rear. The trigonid and talonid are approximately equal in length. The trigonid is composed of three cusps of approximately equal height, the paraconid being the most robust and the protoconid the least so. The metaconid lies on the same level as the protoconid. The paraconid occupies a median position and is bisected by a line which passes through the longitudinal axis of the tooth almost midway between the protoconid and the metaconid. The talonid is basin-shaped and is surrounded by a prominent rim which on the outer side is differentiated into one or two indistinct cusps representing the hypoconid, and on the inner side, entoconid, is slightly crenulated. A cingulum is strongly developed all along the external side; it extends right round the front end of the tooth and only dies away about half way along the internal side.

M_2 is represented by its broken crown in D 250 and appears to have been a moderate-sized tooth, somewhat longer than broad.

The outline of P_4 is the same in each of the referred specimens which show it, as in the holotype, and is elongate oval, broader behind than in front. In D 244, its crown is perfectly preserved except for the fracture of the summit of the principal cusp. The posterior accessory cusp is almost as strong and probably little inferior in height to the main cusp. It lies well on the outside of the median axis. A strong cingulum encircles the tooth on every side.

The anterior premolars are known only by their alveoli. P_3 is slightly smaller than P_4. It is a double-rooted tooth, lying obliquely in the jaw, the posterior root, which is the larger of the two, being on the inside. P_2 is similar to P_3 but still smaller. P_1 is a rudimentary tooth with a single root which lies on the inside of P_2. The canine is an extremely large tooth of an oval cross section, with its antero-posterior diameter almost equal to that of P_4.

The referred left P^4 (D 157), figured in Pl. ii, figs. 16, 16a, is a little-worn tooth, well preserved except for the outer portion of the paracone which is broken away, causing it to appear less robust in the figure than it is in reality. The outline of the tooth is sub-quadrate but with a slight tendency towards a triangular shape on account of the inner side being shorter than the outer one. The antero-posterior is decidedly greater than the transverse diameter. The metacone is a distinct cusp, somewhat shorter than the paracone, and projecting somewhat to the rear. A well developed but low parastyle is present at the antero-external corner. The inner half of the crown contains two well marked cusps, the protocone, which lies somewhat in advance of the paracone, and is inferior to it both in height and robustness, and the hypocone, which is slightly weaker and lower than the protocone. Between them is a faint median cusp. The central portion of the crown is thus considerably contracted and there is little or no tendency for a basin-shaped hollow to be formed between the inner and the outer cusps, such as is a feature of *Lutra* and *Aonyx*. There is a well marked internal cingulum, which runs round the anterior side to join the parastyle and on the posterior side almost joins up with a backwardly projecting shelf which abuts against the blade of the metacone. The dimensions of this and the other referred specimens of this species are collected on page 60.

Remarks and comparisons.—The imperfections of the holotype deterred Matthew (1929, p. 470) from venturing on any generic reference of this species. It is, therefore, fortunate that the referred specimens described above should not only clear up the details of the dental structure and prove the constancy of the characters which Lydekker has already emphasised, but also shed considerable light on its affinities. The later finds also settle the geological horizon of the species. As a matter of fact Lydekker's keen-sighted intuitions founded on slender premises prove to be not so wide of the mark.

As I have already stated (Pilgrim, 1931, p. 74), the mandible and lower dentition afford small grounds for separating this species generically from *Enhydriodon*, that is if my assumption that the M_1 from Hasnot (G. S. I. no. D 161) referred to *Enhydriodon falconeri*, belongs to the genus *Enhydriodon* is correct. Unfortunately conclusive proof of this is lacking, and we cannot exclude a possibility that it belongs to an extremely large species of *Sivaonyx*. Its resemblance to M_1 in the Ipswich mandible referred to *Enhydriodon sivalensis*, already emphasised (page 87), and in the recently discovered ramus of *E. africanus* Stromer (1931, p. 18), supports the more obvious view which I have adopted.

On the same assumption is very largely based the attribution of the P^4 (G. S. I. no. D 157) to the species *Sivaonyx bathygnathus*. It certainly corresponds in size with the rami and lower dentition of that species, and equally certainly its peculiar structure can only be paralleled in *Enhydriodon* amongst the Lutrinæ, though it evidently represents what I conceive to be a more primitive stage of features which in *Enhydriodon* have proceeded to a still more remarkable development. A comparison with P^4 of *Enhydriodon falconeri* (Pilgrim, 1931, p. 75, Pl. ii, figs. 3, 3a) shows at a glance that, in both, in addition to the protocone a strong hypocone exists. These two inner cusps are sufficiently stout either to quite obliterate any central basin-shaped hollow or to tend to do so. Such a basin-shaped hollow is found in *Lutra*, *Aonyx* and all other Lutrinæ, and is encircled by a low semicircular rim on which cusps, if they exist, are only of the nature of serrations. Apart from its inferior size the following differences from *Enhydriodon* may be observed :—(1) the sharper, slenderer and more elongate character of all the cusps, as opposed to their blunter, stouter and more conical character in *Enhydriodon* ; (2) while in *Enhydriodon* the space left between the bases of the four main cusps is negligible, some faint trace of an original hollow area still remains in *Sivaonyx* ; (3) the transverse diameter is relatively greater in *Enhydriodon* ; (4) the metacone is somewhat more elongate in *Sivaonyx* ; (5) the parastyle is somewhat weaker in *Sivaonyx* ; (6) in *Sivaonyx* the internal side of the tooth is relatively shorter, which gives it slightly more of a tendency towards a triangular, as opposed to the rectangular outline in *Enhydriodon* ; (7) the absence of any division in the protocone in the case of *Sivaonyx* ; (8) the absence or at any rate only slight trace of the median cingular cusp often found in *Enhydriodon*. Almost all these differences are such as one might expect to find in a species which while tending to develop in the same direction as *Enhydriodon* was in a more primitive stage. In particular the more elongate character of the metacone in *Sivaonyx* is directly comparable to its even greater elongation in the much earlier *Potamotherium*. It is interesting to notice an increased elongation of the metacone in the Chinji species *Vishnuonyx chinjiensis* (*see* page 94), which otherwise closely parallels the species *Sivaonyx bathygnathus*.

The Chinese species *Lutra aonychoides*, Zdansky (1924, p. 45) suggests in the structure of its P^4 a possible affinity to *Sivaonyx*. Except for the absence of a hypocone, the weaker metacone, the smaller transverse diameter, the rather more triangular shape, the absence of an internal cingulum and of the bulging posterior shelf there is a distinct similarity to *Sivaonyx*, as may be seen from perusing Zdansky's description of the P^4 of *Lutra aonychoides* 'P^4 ist ein sehr massiver Zahn von fast trapezförmigem Grundriss. Gegenüber *Lutra vulgaris* ist der Hauptzacken auf Kosten des hinteren Nebenzackens viel stärker entwickelt. Der Innenzacken ist deutlich ausgebildet und mit der Hinteraussenecke des Zahnes durch ein sehr breites höckerartig emporgezogenes Basalband verbunden. Bei *L. vulgaris* ist dagegen ein ausgesprochener Innenzacken nicht vorhanden. Die vorderhälfte des Zahnes ist mit einem Basalbande versehen, das an der Aussenecke am stärksten ist'. So far as concerns P^4 *Sivaonyx* differs from *Aonyx capensis* in much the same way as it does from *Lutra aonychoides*, but its antero-posterior diameter in *Aonyx capensis* is even greater, the parastyle is weaker, as well as the metacone, while the internal half of the tooth has even less indication of a structure which might develop into a hypocone, there being only a rim encircling a basin-shaped hollow. The outline of the tooth in *Aonyx capensis* is, however, more rectangular than is the case in either *Sivaonyx* or *Lutra aonychoides* owing to the internal side being longer. I do not think, however, that it is feasible to separate *Lutra aonychoides* generically from *Aonyx*, but the Chinese species is certainly more primitive than any living species of *Aonyx* and in addition shows some faint tendency to develop a structure which approaches that of *Sivaonyx*.

From the study of the ramus and lower dentition only of *Sivaonyx bathygnathus*, Pohle (1919, p. 26) classified it with *Potamotherium*, apparently because it happens to possess one more premolar than recent species of *Lutra* and *Aonyx*. The presence of P_1 can, however, hardly be regarded as a proof of genetic affinity, and I have little doubt that it would be found in a more or less rudimentary state in the Pontian ancester of each of the recent otter lines. In *Sivaonyx* it is a vestigial tooth situated on the inner side of P_2, while in *Potamotherium* it forms one of the general row of teeth. In other respects *Sivaonyx* bears only the most distant resemblance to the European Lower Miocene species. In M_1 of the latter the metaconid is very much lower than the other cusps of the trigonid, instead of being actually larger and higher than the protoconid; the paraconid lies almost entirely outside the median axis of the tooth instead of being bisected by it; the talonid is short and narrow, not expanded as in *Sivaonyx*, *Enhydriodon* and *Aonyx*, nor is it hollowed, the hypoconid being high and trenchant, sloping steeply down to the inner margin, where there is hardly a trace of the prominent rim of *Sivaonyx*, *Enhydriodon* and *Aonyx*. The P_4 of *Potamotherium* is almost as narrow behind as in front, whereas in *Sivaonyx* and *Aonyx* it widens considerably towards the rear; the cingulum is narrower; the posterior cusp lies directly behind instead of somewhat on the outer side of the main cusp, and there is a pronounced anterior cusp, absent in *Sivaonyx* and *Aonyx*.

In most of the features mentioned *Aonyx* shows considerable similarity to *Sivaonyx*. The living genus differs in the relatively longer trigonid of M_1; in the further internal shifting of the paraconid, so that it lies almost entirely *inside* of the median axis; in the outer side of the protoconid and the inner side of the metaconid being inclined to one another instead of approximately parallel as in *Sivaonyx*; in the absence of a broad cingulum and a strong postero-external accessory cusp; in P_4; in the smaller canine and in the absence of P_1.

In almost all these characters *Sivaonyx* is closer to *Enhydriodon*, the comparison being more easily possible with the M_1 (G. S. I. no. D 161) referred to *E. falconeri* than with the poorly preserved Ipswich mandible. On the analogy of the palate and upper dentition of *Enhydriodon* we can, however, hardly doubt that the jaw in that genus was shortened; that the lower, like the upper premolar series was reduced; and that the canine and I_3 were larger. We may conclude that *Sivaonyx* exhibits just the characters appropriate to a form ancestral to *Enhydriodon.* It is interesting to note that some of its primitive features are shown in the earlier species *Enhydriodon campanii*, as compared with *Enhydriodon sivalensis*, such as a longer jaw; a less reduced premolar series; and in P^4 an inferior transverse diameter, a more anterior protocone and a weaker parastyle. Since, however, *E. campanii*, though possibly earlier in age than *Sivaonyx bathygnathus*, already possesses the bunodont character of *E. sivalensis*, it is obvious that the fossil Indian genus cannot be regarded as the direct ancestor of *Enhydriodon*, but that both are descended from an earlier perhaps Middle or even Lower Miocene form, not differing greatly from *Vishnuonyx chinjiensis.*

Aonyx may have sprung from a closely allied form in which the hypocone is still absent. It has remained closer to the hypothetical stem in its failure to develop a hypocone in P^4, traceable, however, in a rudimentary condition in *Lutra aonychoides*, in the longer trigonid of M_1, in its smaller canine, while on the other hand the increase of the antero-posterior diameter of P^4 on the internal side gives that tooth a more rectangular outline than in *Sivaonyx.* As already suggested (page 83), *Potamotherium* seems more likely to have been on the direct stem leading to *Lutra*, which is probably distinct from that on which lay *Vishnuonyx*, *Sivaonyx*, *Aonyx* and *Enhydriodon.* This view seems to find support in the deductions which I have drawn from the foot bones of *Enhydriodon* (?) *latipes* (Pilgrim, 1931, p. 72) also referred to above (page 83).

Genus: VISHNUONYX, nov.

Diagnosis.—Lutrinæ of rather small size; having a P^4 of triangular shape; antero-posterior diameter on the outer side much exceeding that on the inner side, and also much exceeding the transverse diameter; with a high, pointed paracone; metacone lower but elongated; parastyle weak; with two internal cusps, protocone and hypocone, both much lower than the paracone; protocone situated rather far forward; with a slight internal cingulum; M^1 rather small; mandible with a deep ramus; P_4 elongate, only slightly broader posteriorly; with a strong posterior accessory cusp, not situated so much to the outside of the main cusp as in *Sivaonyx*, without an anterior accessory cusp; with a broad cingulum; M_1 with talonid broader and shorter than trigonid, surrounded by a crenulated rim, of which the entoconid is as strong as the hypoconid; M_2 elongate oval, rather longer than in *Sivaonyx.*

Genotype.—Vishnuonyx chinjiensis, sp. nov.

VISHNUONYX CHINJIENSIS, sp. nov.

(Pl. II, fig. 17; Pl. IV, fig. 6.)

Diagnosis.—This is the only species known and the diagnosis is that of the genus.

Holotype.—The left maxilla containing P^4 and a fragment of the root of M^1 described below and figured in Pl. ii, figs. 17, 17*a*. It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 223.

Referred specimen.—A fragmentary right mandibular ramus from Chinji (G. S. I. no. D 245) figured in Pl. iv, figs. 6, 6*a* of the present work, containing P_4, the anterior root and the crown of the talonid of M_1, and the broken base of M_2.

Locality.—Both the holotype and the referred ramus were collected near Chinji, Salt Range.

Horizon.—The upper portion of the Chinji stage of the Lower Siwaliks.

Description.—P^4 in the holotype is a tooth of a triangular shape, the angle between the anterior and external sides being approximately a right angle. The external side is about half as long again as the anterior side. The crown contains four cusps. Of these the paracone is the highest and is tall and pointed; the metacone has had its summit broken off, but it is easy to see its outline at any rate in the actual specimen; it is lower than the paracone but considerably elongated; the two inner cusps are much lower than the outer ones; of these the hypocone is lower than the protocone. The protocone is situated very distinctly in advance of the paracone. The parastyle is not very strongly marked. There is a slight cingulum, most distinctly indicated on the hinder margin between the hypocone and the metacone, but also visible internally and anteriorly. The crown of M^1 is not preserved but it may be inferred from the fragment of the root still left as well as from the unbroken surface of the maxilla that it was a smaller tooth than in most of the otters.

The referred right ramus (G. S. I. no. D 245) is broken off in front of P_4 but the crown of P_4 is almost perfect except for the loss of the summit of the principal cusp. Of the crown of M_1 only the talonid is preserved, but the anterior portion of the tooth is represented by its root. The broken base of M_2 is shown, and the front part of the masseteric fossa, but the coronoid process, the condyle and the angle are missing. The structure of the parts of the ramus preserved in this specimen is remarkably similar to that of the ramus of *Sivaonyx bathygnathus.* The depth of the ramus is approximately the same relatively as in the Hasnot species, and the deep masseteric fossa characteristic of the otters can be plainly distinguished. Its dimensions agree very well with those of the holotype P^4. P_4 is oblong-oval, slightly broader in its posterior part but less so than in *Sivaonyx bathygnathus.* There is a high main cusp, a strong posterior cusp, rather less outwardly situated than in the Dhok Pathan species and a broad cingulum. The broad basin-shaped talonid of M_1 with its crenulated rim is almost identical with that of *Sivaonyx bathygnathus*, but seems to be shorter relatively to the trigonid than in the latter species. M_2 does not show the structure of the crown but it seems to be longer than in *Sivaonyx bathygnathus*. Its measurements as well as those of the holotype are on page 60.

Remarks and comparisons.—Had it not been for the existence of the fossil *Enhydriodon* and *Sivaonyx* material from India previously described, but especially of the P^4 referred to *Sivaonyx bathygnathus*, it might have been difficult to classify the holotype. It presents characters approximately midway between *Potamotherium valetoni* and *Sivaonyx bathygnathus*. Thus the outline of the tooth, which in *Sivaonyx bathygnathus* showed only a tendency to assume a triangular shape, may here be described as perfectly triangular. This is caused partly by the two internal cusps being closer together, partly by the more external position of the hypocone, and partly by the prolongation of the metacone. The latter character is precisely comparable to what occurs in such a primitive Lutrine species as *Potamotherium valetoni*. On the other hand the internal portion of the crown is quite different from *Potamotherium valetoni*. In most of the specimens referred to the latter species there are not two distinct cusps but only a crenulated semicircular ridge. In one case I have seen two faintly marked cusps and no more, but in this case the cusps were partially united both to one another and to the external lobes, instead of a broad open valley being left between the internal and the external cusps as in *Vishnuonyx chinjiensis*. The parastyle in this species is weaker than is the case in *Sivaonyx bathygnathus* or in *Potamotherium valetoni*. The presence of an internal cingulum allies it with *Sivaonyx* rather than with *Potamotherium*. Although the crown of M^1 is broken away, yet it is evident both from the fragment of the root which is still left as well as from the unbroken surface of the maxilla that it was a much smaller tooth than in *Aonyx capensis*, *Enhydriodon sivalensis* and in most of the otters except possibly some of the *L. sumatrana* group. In *Potamotherium* not only was M^1 equally small or probably smaller, but M^2 was also present. All the same, in spite of some of the resemblances between this species and *Potamotherium valetoni*, it does not seem likely that the latter was the ancestor of *Vishnuonyx chinjiensis*, since the resemblances seem to be primitive survivals in *Vishnuonyx* while the differences are adaptive and indicate that the two lines had diverged in the Miocene.

Strong confirmation of the view that the P^4 just described belongs to a species allied to but smaller than and ancestral to *Sivaonyx bathygnathus* is afforded by the discovery in the same beds near Chinji of a left mandibular ramus, which almost reproduces in miniature the characters of the rami of *Sivaonyx bathygnathus*. In those respects in which it differs from *Sivaonyx bathygnathus* it shows an approximation to the genus *Potamotherium*, which is probably explicable in the same way as that suggested in the case of the upper dentition. The posterior widening of P_4 is less than in the Hasnot species and the posterior cusp is situated rather more behind the principal one. In both particulars it is somewhat intermediate between *Sivaonyx bathygnathus* and *Potamotherium valetoni.* The cingulum is, however, as marked as in the Hasnot species, and the anterior cusp of *Potamotherium valetoni* is equally absent. The large basin-shaped talonid of M_1 surrounded by a crenulated rim is a striking feature of difference from *Potamotherium.* M_2 seems to have been relatively rather longer than in *Sivaonyx bathygnathus.*

Both these specimens from Chinji are in accord with the view that *Vishnuonyx chinjiensis* is the earliest member at present known of a Lutrine line, which branched off from that which led from *Potamotherium* to *Lutra* and most other living otters; that it was ancestral to the Dhok Pathan *Sivaonyx;* that either this or a closely allied, possibly earlier species may even have been the ancestor of the genus *Enhydriodon* which is almost a contemporary of *Sivaonyx.* *Aonyx* probably branched off still earlier and pursued a course of evolution nearly parallel to but distinct from that of *Vishnuonyx* and *Sivaonyx.* More material is needed definitely to establish the truth of the above view, but for the present it may serve as a working hypothesis.

Sub-order : ÆLUROIDEA, Flower.

Diagnosis.—Carnivora with tympanic more or less forming a segment of a ring, which furnishes only the outer or front part of the auditory bulla (ectotympanic) the inner or hinder part being the entotympanic (os bullae); the two portions are separated by a septum; carotid canal short or absent; maxilloturbinal small, twisted, not excluding the naso-turbinal and the upper ethmoturbinal from the anterior nasal opening; os penis large, small or absent.

Family : *VIVERRIDÆ.*

Diagnosis.—Aeluroidea with low, elongated skull; long muzzle; not specially inflated brain case; alisphenoid canal generally long and its posterior opening large; entotympanic portion of auditory bulla large, separated by a septum and an external furrow from the smaller, forwardly placed ectotympanic; external auditory meatus short; mastoid process small, hardly separable from the bulla; paroccipital process strong, surrounding and overtopping the hinder wall of the bulla; dental formula $\frac{3.1.4.2}{3.1.4.2}$; M^1 and M^2 relatively large, tritubercular; M_1 with relatively short, high trigonid, strong metaconid and basin-shaped talonid; M_2 relatively long, tritubercular; extremities relatively short and slender, digitigrade, or subplantigrade; manus and pes 5-dactyl, rarely 4-dactyl; claws retractile or not; os penis large or moderate.

Sub-family : *VIVERRINÆ.*

Diagnosis.—Viverridæ with auditory bulla oval or rather conical, broad and truncated, and not everted behind, narrow in front and more or less compressed at the sides; ectotympanic very small and flat; external auditory meatus with scarcely any lower lip, its orifice being close to the tympanic ring; paroccipital process triangular, its apex projecting slightly beyond the bulla; claws strongly curved and more or less retractile.

Measurements of Indian Fossil Viverridae and of the recent Viverra zibetha.

—	*Viverra zibetha.*	*Viverra (?) chinjiensis* (G. S. I. no. D 214).	*Vishnuictis salmontanus* (G. S. I. no. D 160).	*Vishnuictis durandi* (Br. Mus. no. M. 1338).
Distance from ant. border of nasal foramen to the bifurcation of sagittal crest.	92·0	..	82·0	..
Distance from incisor border to occipital crest	145·0	..	app. 127·0	..
Distance between hinder end of M^2 and front end of canine.	54·0	..	49·6	..
Width of skull at nasals	25·0	..	20·5	34·0
Width of skull at jugal processes of maxilla	65·0	..	app. 52·0	app. 69·0
Width of skull between post-orbital processes	27·5	..	26·5	45·5
Width of brain case at posterior root of zygomatic arch.	41·5	..	app. 33·0	50·0
Height of skull at infra-orbital foramen from base of P^3 to upper surface of frontal.	30·5	..	30·5	39·5
Length of P^1-P^3	21·5	..	21·0	..
Ant. post diam. of upper molars	13·0	..	11·0	18·0
P^4 ant. post. diam.	14·5	..	11·0	19·5
P^4 trans. diam.	8·6	..	7·7	..
M^1 ant. post. diam.	8·2	..	app. 6·3	..
M^1 trans. diam.	13·0	..	8·6	..
M^2 ant. post. diam.	4·2	..	4·1	..
M^2 trans. diam.	6·7	..	6·2	..
Lower dentition—				
C ant. post. diam.	..	5·3	..	..
C trans. diam.	..	3·5	..	..
P_1 ant. post. diam.	..	3·0	..	..
P_1 trans. diam.	..	1·5	..	..
P_2 ant. post. diam.	..	6·5	..	..
P_2 trans. diam.	..	2·5	..	..
P_4 ant. post. diam.	..	7·5	..	..
P_4 trans. diam.	..	4·0	..	..
M_1 ant. post. diam.	14·3	10·0	app. 10·4	..
M_1 trans. diam.	..	5·2	..	..
M_2 ant. post. diam.	5·2	5·7	5·0	..
M_2 trans. diam.	..	4·5	..	..
Depth of ramus beneath M_1	17·2	12·0	13·3	..
Thickness of ramus beneath M_1	..	5·0	..	..
Diastema between canine and P_1	..	1·0	5·0	..

Genus : VIVERRA, Linné.

Diagnosis.—Viverrinæ with teeth stouter and less compressed than in the other genera; auditory bulla smaller and more pointed in front; M^2 larger; P^4 with small parastyle; claws longer and less retractile.

VIVERRA BAKERII, Bose.

1868. *Canis* ? sp., Falconer, Pal. Mem. I, p. 553 unpublished plate Q. figs. 1, 3.
1880. *Viverra bakerii*, Bose, *Quart. Journ Geol. Soc. London*, XXXVI, p. 131.
1884. *Viverra bakeri*, Lydekker, *Pal. Ind.* (10), II, p. 268, Pl. xxxiii, figs. 1, 2.

Diagnosis.—A *Viverra* of large size, nearly equal to that of *V. zibetha*, with skull characters approximately as in that species; except that the palate is slightly broader in its hinder portion and more backwardly extended; antero-posterior diameter of P^4 exceeding that of the united M^1 and M^2; M^1 relatively larger than in *V. zibetha*, and having its internal antero-posterior diameter still greater than in that species, so that the outline becomes sub-oblong instead of sub-triangular; M^2 considerably larger than in *V. zibetha*; angle between the borders of M^1 and M^2 and the axis of P^4 about 125° as against about 120° in *V. zibetha*; P^3 rather large.

Holotype.—The skull described by Bose (1880, p. 131) and figured by Lydekker (1884, p. 268, Pl. xxxiii, figs. 1, 2). It is in the British Museum regd. no. 40183.

Locality.—The Siwalik Hills.

Horizon.—Upper Siwaliks, probably Pinjor stage, but uncertain.

Referred specimen.—A left maxilla in the British Museum (no. 40180), also from the Siwalik Hills, described and figured by Lydekker (1884, p. 270, Pl. xxxiii, fig. 2).

Remarks.—It does not seem possible to add more of real value to what Lydekker has already said about the affinities of this species. He remarks (1884, p. 270) :—'The species must be regarded as intermediate between *Viverra zibetha* and *Civettictis civetta*, its P^4 having attained the proportions of that of the former, while the upper molars retain the large size of those of the latter', and on p. 271 'the megalocreodont character of *V. bakerii* indicates that it cannot in all probability have been the ancestor of *Civettictis civetta*: it is, however, extremely probable that it may have given rise to *V. zibetha*, the reduced size of the molars in the latter being a later specialization'. Mathew (1929, p. 488) is more inclined to the reverse conclusion 'as the teeth of *V. bakerii* look like a species progressively adapting for less carnivorous diet'. It will be shown below (pp. 101—106) that *Vishnuictis salmontana* and *V. durandi* are not closely related either to this or to the recent species named above, but the increase of length of the carnassial tooth from the earlier to the later of these two species of *Vishnuictis* is certain; so that it seems to me that Lydekker's view of the progressive development of P^4 in the Viverrinæ has at least as much in its favour as Matthew's contrary opinion.

Neither of the specimens seems to display characters which enable us definitely to assign the species to the genus *Civettictis*, according to the skull characters of that genus as diagnosed by Pocock (1915, p. 149). The basicranium which is shown on the species *Vishnuictis durandi*, is destroyed on the specimens of *V. bakerii.* Were it not for the faint suspicion of an inner cusp in the large Indian species *V. megaspila*, I should be inclined to regard that species as a more likely descendant of *V. bakerii*, since the two species agree in regard to the broader and more backwardly extended palate, a more prominent parastyle on P^4 and the shape and size of M^1. M^2 has, however, become more reduced in *V. megaspila.*

VIVERRA (?) CHINJIENSIS, sp. nov.

(Pl. IV, figs. 9, 10.)

Diagnosis.—A *Viverra* of small size, with a large M^1 and M_2; talonid of M_1 and M_2 with cusps, which rise from the rim that encircles the basin, less prominent than in other species.

Holotype.—The right mandibular ramus with the almost complete cheek dentition including the canine but with P_3 missing except for its extreme front end. It is figured in Pl. iv, figs. 9, 9*a* of the present work. Also the associated M^1 in a fragmentary condition, figured in Pl. iv, fig. 10 of this work. These are in the collection of the Geological Survey of India in Calcutta regd. no. D 214.

Locality.—Kukar Dhok, near Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The right mandibular ramus (G. S. I. no. D 214) which forms a part of the holotype is broken off behind M_2, but shows most of the teeth in an early stage of wear and well preserved, except the incisors, which are only known by their alveoli, the tip of the canine and the greater part of P_3, only the extreme front end being preserved. The incisors seem to have been small teeth. The canine was as stout a tooth as is usually the case in the Viverridæ, very slightly flattened internally and with a vertical ridge on the postero-internal side. P_1 is a one-rooted tooth with a single cusp, having a gentle slope from summit to base behind and a more abrupt slope in front. It lies immediately behind the canine with a diastema of no more than one millimetre. P^2 is a two-rooted tooth, of which the anterior and posterior slopes are of corresponding steepness to those of P_1. There is an anterior basal cusp and a posterior basal cingulum. Half way up the slope between the latter and the summit is a small cusp. P_3 is broken, but is probably a similar tooth to P_2. P_4 is similar in character to P^1 but larger. Both the anterior cusp as well as the posterior basal cingulum are more pronounced, while the intermediate cusp is much stronger and rises very near the base of the tooth. On its inner side the cingulum is extremely broad and its margin is slightly crenulated. M_1 consists of a trigonid and a talonid of which the latter is only a little less long than the former. The metaconid is distinctly the smallest of the three cusps and is only half the height of the protoconid. The paraconid is twisted round to the inside so that the median line of the tooth, which passes between the protoconid and the metaconid, bisects it. The talonid consists of three main cusps, of which the hinder one is worn but is not far behind the other two. The two front cusps rise from crenulated ridges running forward to the trigonid. In fact all three cusps are so low that the talonid may be almost considered as a hollow enclosed by a crenulated wall. M_2 consists of four main cusps, but as in the case of the talonid of M_1 they are connected by a crenulated ridge which forms a wall round a central hollow. The measurements are on page 97.

The associated upper molar is evidently M^1. On account of its fragmentary condition the outline is not quite certain, but it is obviously a large tooth in proportion to the size of M_1, its antero-posterior diameter, especially on the inner side, being greater than is usual amongst the Viverridæ. There is a strong parastyle and a narrow but sharply defined cingulum on the inner side, which also extends a short distance both on the front and on the hinder margins.

Remarks and comparisons.—The character of the associated M^1 furnishes even more conclusive evidence of the Viverrid nature of this species than the better preserved mandible, especially the size and nature of the cingulum. Such a cingulum as this is often found amongst the Viverridae; it is altogether different from the broad posterior cingulum which characterises the Mustelidae. Among Viverrid genera the only ones which possesses such a long talonid to M_1 are *Amphictis* and *Viverra. Amphictis* is clearly distinguished by the long two-rooted M_2. In *Paradoxurus*, which offers resemblances to the present ramus, the talonid of M_1 has three high, pointed cusps, which are quite unlike the basin-shaped talonid of the M_1 before me.

In most species of *Viverra* the cusps which surround the talonid of M_1 are higher than is the case in the present species, and the same is true of the four cusps which encircle the crown of M_2. *Vishnuictis salmontanus* is of somewhat larger dimensions; has a more robust ramus; a shorter talonid to M_1 and a smaller M_2. Amongst recent species the nearest is *Viverra tangalunga.* This agrees exactly in size with our specimen. The disposition and size of the cusps of the trigonid of M_1 are identical and the cusps both in the talonid of M_1 and in M_2 correspond very closely, except that in the fossil species they are less pronounced. The differences between the two species are the larger dimensions of M_2 in the fossil and the lesser prominence of the cusps in the talonid of M_1 and in M_2; they merge into the general encircling wall in a way which is not so noticeable in *V. tangalunga.* The premolars are almost identical in the two species, but in none of the four is the posterior basal cingulum as strong in the fossil as in the recent species. Further in *V. tangalunga* the tooth series is longer, corresponding to a diastema of three millimetres behind the canine.

VIVERRA KARNULIENSIS, Lydekker.

Holotype.—The left mandibular ramus containing the alveoli of the premolars and the somewhat worn M_1 described and figured by Lydekker (1886, p. 31, Pl. vii, figs. 6, 6*a*). It is in the collection of the Geological Survey of India in Calcutta regd. no. F 227.

Locality.—The Billa Surgam Caves, Karnul district.

Remarks.—It is true, as Lydekker has stated, that the species is distinguished from *V. zibetha* by the much greater length of the premolar series. It has, however, escaped his notice that this is precisely one of the characters which distinguishes the type of *V. megaspila* sub sp. *civettina* Blyth which is contained in the Indian Museum (No. 10393) from the common Indian species of civet.

The material of *V. karnuliensis* does not indeed enable me to separate the two species which may actually be identical.

Genus: VISHNUICTIS, nov.

Diagnosis.—Viverrinae of medium to large size, with elongated, high and narrow skull; contracting gradually but up to a considerable distance behind the post-orbital processes, also contracting in front of the post-orbital processes; slender muzzle; sides of face steeply descending from a nasal maxillary ridge; teeth not compressed laterally and with rather blunt cusps; brain case exceptionally narrow; upper molars rather large, relatively broad internally; P^3 without an internal cusp; premolar series rather spaced, premolars simple; mandible rather stout but shallow; M_1 with relatively long trigonid, relatively short talonid; M_2 rather large, oblong.

Genotype.—*Vishnuictis salmontanus*, sp. nov.

Species.—Besides the genotype, which belongs to the Dhok Pathan stage of the Middle Siwaliks, I refer to the genus the much larger species *Viverra durandi* Lydekker from the Upper Siwaliks.

Remarks.—The affinities of the genotype to existing and fossil Viverrinae are discussed below. Although in most of its characters the genus is essentially Viverrine, yet the extreme height and slenderness of the skull entirely prohibit a reference to any existing Viverrine genus. The Upper Siwalik species *V. durandi* shows most of the peculiar characters of the genus, but is much larger and apparently more advanced, and probably represents a terminal form of the line, which is not phylogenetically related to the living *Viverra zibetha.*

VISHNUICTIS SALMONTANUS, sp. nov.

(Pl. IV, figs. 7, 8.)

Diagnosis.—A *Vishnuictis* of small size and with a more slender muzzle than *V. durandi*; having P^4 equal in length to the united lengths of M^1 and M^2; angle between P^4 and the upper molars about 140°; outer border of M^2 external to that of M^1, its inner border also lying more externally than that of M^1.

Holotype.—The conjoined skull and mandible figured in Pl. iv, figs. 7, 8, which is in Calcutta in the collection of the Geological Survey of India regd. no. D. 160.

Locality.—Hasnot.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description.—The holotype consists of a united skull and mandible of a fully grown individual, which, though imperfect, shows no sign of crushing or distortion. The frontal, maxillary, and nasal portions are complete, but from a point not far behind the beginning of the sagittal crest, the bone that covers the cranial cavity is present only in small patches so that the infilling matrix preserves a cast of the cerebral hemispheres. Not only is the occipital bone missing but also the cast of the cerebellum and the zygomatic process of the squamosal, while the basi-cranial region is too poorly preserved to afford any idea of the structure. The hinder part of the right mandibular ramus has been detached from the maxilla, so as to expose, though in a somewhat broken condition, the upper P^3 to M^2 and the lower M_1 and M_2. The angle and coronoid process of the mandible are for the most part only known by the impression which they have left on the sandy matrix.

The skull belongs to a Viverrid animal of medium size, probably slightly larger than *Viverra tangalunga.* The upper profile is similar to that of most species of *Viverra.* Excluding the sagittal crest, which is broken away in the fossil, the highest point is somewhat behind the post-orbital processes. Thence it descends very slightly to the occipital crest, and a little more steeply to the front, rising again towards the end of the nasals, so that the nasals form a slight concavity. The skull is extremely slender. The width of the brain case only exceeds that at the post-orbital processes by about six mm. and between these points the skull contracts gradually and not abruptly as is the case in most other Viverrines but the narrowing extends over a considerable distance. The muzzle is also very narrow, being six mm. less in width than that between the post-orbital processes. On the other hand the height is considerable, being only about two mm. in defect of the width of the brain case. The occipital appears to be high and narrow. The paroccipital and mastoid processes as well as the bulla and the basicranium are too much broken or covered with matrix to afford an opportunity for detailed study. The frontals are convex transversely at the post-orbital processes but the latter are not especially prominent. The orbits open widely into the temporal fossa, are not particularly narrow in front and end opposite the middle of P^4. The maxillae form a slight projection into the orbit about half way between its upper and lower edges, as is the case in *Viverra zibetha.* The infra-orbital foramen is large and circular and separated by about seven mm. from the orbit. It is situated over the hinder half of P^3 and the front portion of P^4. The mid line of the frontals is depressed. This depression passes into a deep internasal hollow. The upper posterior surface of the muzzle is bordered by the nasal-maxillary suture which forms a remarkably sharp ridge. Below this the surface of the maxilla descends very steeply to the level of the zygomatic process of the jugal and in front of this to the alveolar margin of the anterior premolars. The upper surface of the maxilla above and anterior to the orbit is somewhat hollowed. The maxilla extends a considerable way behind the anterior margin of the orbit and ends about 12 mm. in front of the post-orbital process. The orbit is bordered by only a very short process of the frontal, and apparently an equally short frontal process comes between the maxilla and the nasal, but the sutures are not plainly visible. The limits of the premaxilla are not plainly seen and the front end of the anterior nasal foramen is broken away, but its margins rise more steeply and higher than in *Viverra zibetha.*

Dentition.—M^1 has the antero-posterior diameter considerably more than half the transverse diameter, anterior border convex, posterior border concave, parastyle very prominent and projecting outward much beyond the metacone, inner half of the tooth rather broad, with much the same relations to the breadth of the outer half as in *Viverra zibetha.* M^2 rather large, the anterior transverse diameter almost as great as the posterior transverse diameter of M^1, sub-oblong but with prominent parastyle, antero-posterior diameter approximately equal both on the inside and the outside of the tooth, but the extreme inward end is slightly narrowed. The angle between the axis of P^4 and that of the upper molars is about 140°. M^2 is somewhat more externally placed than M^1, so that the outer borders of these teeth is not a continuous line, while the line joining their inner borders runs obliquely outward from M^1 to M^2. P^4 with antero-posterior diameter equal to that of the united M^1 and M^2, not particularly slender, with moderately high paracone, metacone rather lower, small low parastyle, protocone rather prominent. P^3 has a moderately high main cusp with a steep anterior edge, not keeled and with little or no trace of an anterior cingulum, the posterior edge less steep and passing gradually into a well marked heel but without any definite accessory cusp. P^2 similar to P^3 but smaller and with a smaller posterior heel separated from P^3 by a diastema of about two mm. P^1 moderately high crowned, conical with sub-circular cross section, one-rooted, separated from P^2 by a diastema of about two mm. and from the canine by a diastema of about three mm. Upper canine rather large, with elongate oval cross section at base of crown, about as long as P^2. The incisors are missing. Mandibular ramus relatively stoutly built, but shallow, regularly convex lower border, except for a slight concavity behind M_2; symphysis narrow, flat and long. Masseteric fossa deep and well defined, coronid process moderately steep and high. M_1 not particularly slender; trigonid rather long, slightly longer than the combined length of the talonid of M_1 and M_2; paraconid lying internally to the protoconid; metaconid much shorter than protoconid; talonid about half the length of the trigonid; its surface is so much destroyed that the details of structure cannot be observed. M_2 is very worn and only the two posterior cusps of the crown can be seen. Its antero-posterior diameter is slightly greater than the transverse diameter; it tapers slightly at the rear. The lower premolars are not well exposed. P_3 has a strong posterior heel and a faint anterior one. P_1 is one-rooted and sub-conical. There is a diastema of about two mm. between it and P_2 and of about five mm. between it and the canine. The measurements of the skull and mandible are tabulated above (page 97) together with those of some other Viverrine species.

Remarks and comparisons.—The foregoing description and the figures will not leave room for doubt as to this species being a Viverrid. The shape and number of the upper molars distinguish it from the Mustelidæ. The slender skull, in particular the brain case, and the structure of P^4 with an oblique shear and a small parastyle are quite unlike those of the Canidæ, while its less robust character and the weaker parastyle of P^4 distinguish it from *Ictitherium.* Nothing in its structure is reminiscent of any of the Felidæ.

Of the two Viverrid sub-families, the Herpestinae and the Viverrinæ, the shape of the skull and certain features in the dentition militate against a reference to the former. *Herpestes* differs in its shorter face, its posteriorly closed orbits and the presence of an internal cusp in P^3, while the skull is pinched in behind the post-orbital processes. *Crossarctus* and *Suricata* are allied to *Herpestes;* the former has a short face and a broad brain case and though the orbits are not closed behind, the post-orbital processes are well developed and the skull is much pinched in behind them. *Suricata* has closed orbits and the brain case is broad, though the skull is not pinched in behind the post-orbital processes. *Bdeogale* and *Helogale* agree with the Herpestinæ in skull characters.

Both the skull and dentition of *Arctogale*, *Cynogale*, *Galidictis*, *Eupleres* and certain other Viverrids which have been generically distinguished and in some cases given sub-family value are too widely removed from those of the Hasnot skull to cause any confusion.

Of the various genera referred to the sub-family of the Viverrinæ, *Prionodon* and *Poiana* are easily distinguished by the absence of M^2. *Paradoxurus* has a shorter face than the Hasnot specimen, its P^3 has a strong internal cusp, M^1 is more quadrate, M_1 is much broader in proportion to its length and the tooth cusps are lower and blunter.

The characters observable in the Hasnot skull are perhaps hardly adequate to connect it with one rather than another of the four genera *Viverra, Viverricula Civettictis* (=*Viverra civetta*) and *Genetta,* but in any case it seems to me almost certain that the remarkable height of the skull, in which it differs from all of them, amply entitles it to generic distinction. Apart from this the present species differs from *Genetta* in its stouter teeth, with blunter cusps, its much less transversely extended M^1, its larger and more quadrate M^2, the absence of an inner cusp on P^3, the stouter mandibular ramus, the longer talonid in M_1 and the more elongate M_2. Having regard to the fact that the species exceeds the recent *Genetta* in size, in spite of its Pontian age, the differences mentioned seem to militate against its having any close affinity to that genus.

The other three recent genera mentioned differ from *Genetta* to a greater or less degree in all the characters which distinguish that genus from the Hasnot species and the possibility of a genetic relationship between one of them and *Vishnuictis* deserves some consideration. It is evident that the skull now before me is perfectly distinct from that of each of the three well defined living species of *Viverra, V. zibetha, V. tangalunga* and *V. megaspila* as well as from *Civettictis civetta* and *Viverricula malaccensis. Viverricula malaccensis* is not only much smaller than the present form but also the post-orbital processes are more extended transversely and the skull is proportionately more squeezed in behind them, the brain case being relatively broader. Moreover both M^1 and M^2 are shorter and more extended transversely. The slender muzzle and the shape of the maxillary surface, which descends steeply from the frontal, remind one, however, of the similar condition in *Viverricula malaccensis.* In point of size the new species is closer to *V. tangalunga,* only slightly exceeding it in size. The brain case is, however, broader and the pinching in of the skull behind the post-orbital processes is more pronounced than in the fossil, while the muzzle is broader and the slope of the maxillary surface is much gentler. *V. zibetha* and *V. megaspila* are much larger than the fossil but in regard to the relation between the breadth of the skull at the post-orbital processes and at the brain case as well as in the degree to which the skull is pinched in behind the post-orbital processes the similarity is greater. The three skulls are not, however, identical, since in the fossil the breadth at the post-orbital processes is relatively greater and the width of the brain case relatively less than in either of the living species. Moreover the muzzle is higher and more slender in the fossil and the slope of the maxillary surface is much steeper. *Civettictis civetta* is as large as or larger than *V. zibetha* and the breadth at the post-orbital processes is even greater than in that species. M^1 and M^2 and M_2 are markedly larger than in *V. zibetha* and the present species, but I do not feel justified in inferring from that character a phylogenetic relationship with one rather than with the other of the two recent species.

If we compare the present specimen with the living species in respect to the dentition certain differences are very noticeable. In the fossil the length of P^4 is equal to that of the united lengths of M^1 and M^2, whereas in *V. zibetha, V. megaspila, V. tangalunga* and *Viverricula malaccensis* the former dimension is the greater. On the contrary in *Civettictis civetta* the latter dimension is the greater. Lydekker has observed (1884 p. 270) that the increase in size of P^4 indicates higher specialisation and that therefore *V. zibetha* is more specialised than *Civettictis civetta.* The same argument leads to the conclusion that *V. salmontanus* is less specialised than *V. zibetha* or the other species which have a large P^4. This indeed is reasonable when one considers its much greater age. The point is discussed above p. 98. Of the molars, whereas M^1 in *V. zibetha* is relatively longer and broader than in *V. salmontanus,* M^2 is much more nearly the same size in the two species. The same applies to M_2. In *Civettictis civetta* both M^1 and M^2 are much larger than in *V. salmontanus.* Another striking feature in the fossil as compared both with *V. zibetha* as well as with *Civettictis civetta* and the other living species is the greater length of the first three premolars, being most marked in the case of P^1. In *V. zibetha* the lower premolars agree with those of the fossil in the absence of an anterior cusp. This cusp is present in *V. tangalunga,* and *V. megaspila, Viverricula malaccensis* and *Civettictis civetta.* The fossil agrees with *V. zibetha* and the other Asiatic species of *Viverra* in the small size of the metaconid of M_1. In *Civettictis civetta* on the contrary the metaconid of M_1 is almost as high as the protoconid.

It is therefore evident that although certain features in the Hasnot species might be compatible with the theory that it is a more primitive form on the same line as one of the recent species, yet even apart from the height of skull it possesses characters which incline me to place it on a distinct branch.

In comparing the specimen with the various fossil species ascribed to *Viverra,* we must bear in mind the possibility that many of the European species referred to *Viverra* may belong to the genus *Herpestes,* or be distinct from either, since their remains are generally extremely fragmentary. With regard to the two Indian fossil species *Viverra bakerii* and *Viverra durandi,* collected from the Upper Siwaliks of the Siwalik Hills by Falconer and described by Bose (1880, p. 131) and Lydekker (1884, pp. 268-274), there is sufficient skull material to leave no doubt that they both belong to the sub-family Viverrinæ.

The better preserved of these two species is *V. durandi.* As Lydekker has said it greatly exceeds in size any other known species of the genus, but in most other characters the resemblance to the fossil skull is remarkable, particularly in the relative breadth at the post-orbital processes, and the contour of the skull both in front of and behind them. The height of the skull in front of the orbits and the steeply descending maxillary surface are similar in both. The muzzle is relatively a little more slender in *V. salmontanus* than in *V. durandi* and P^4 in the Upper Siwalik species exceeds in length the united lengths of M^1 and M^2 instead of being equal to them as in *V. salmontanus.* The latter difference is, however, what might be expected in a more primitive species, and on the whole it seems probable that the Dhok Pathan species *V. salmontanus* is the direct ancestor of the Upper Siwalik *V. durandi.* If I am right in assuming a phylogenetic connection between these two species, then the likelihood that *Viverra zibetha* or another recent species is on the direct line of descent from either of them is still further diminished. On the contrary the exceptionally large *V. durandi* probably represents the terminal member of a branch, which split off from the still existing lines at a much earlier date.

VISHNUICTIS DURANDI (Lydekker).

1868. *Canis* (?) sp., Falconer. Pal. Mem. I, p. 553.
1884. *Viverra durandi,* Lydekker, *Pal. Ind.* (10) II, p. 271, Pl. xxxiii, fig. 3.

Diagnosis.—A *Vishnuictis* of very large size; with a somewhat shorter and less slender muzzle than in *V. salmontanus*; premolar series more crowded than in *V. salmontanus*; length of P^4 greater than the united lengths of M^1 and M^2; angle between the axes of P^4 and the upper molars about 115°; outer borders of M^1 and M^2 continuous, their inner borders being in the same antero-posterior line.

Holotype.—The skull described and figured by Lydekker (1884, p. 271, Pl. xxxiii, fig. 3). This is in the British Museum regd. no. M 1338.

Referred specimen.—A skull lacking the hinder part of the occiput (Br. Mus. no. 37150) mentioned by Falconer (Pal. Mem. I, p. 553) under the name of *Canis* (?) sp. and figured in Fauna Antiqua Sivalensis unpubld. Pl. Q, figs. 2, 2*a*. It was described by Lydekker (1884, p. 273) without a figure.

Locality.—Both the holotype and the referred skull came from the Siwalik Hills.

Horizon.—Upper Siwalik, probably from the Pinjor stage, but uncertain.

Remarks.—Both the holotype and the referred skull have been described by Lydekker (1884, pp. 271-274) but the holotype was only figured from the palatal view and the referred skull was not figured at all. Since the reference of the species to the genus *Vishnuictis* is mainly based on the height and on the conformation of the upper portion of the skull, I have thought that two additional figures representing the skull of this species from the side and from above might be of value. These two views of the holotype skull are shown in text figs. 1 and 2, p. 107. Its measurements are included in the table on page 97.

The specimens have been fully described by Lydekker and little need be added here. He points out the resemblances of the skull and dentition to those of *Viverra*, and in particular to *V. zibetha*, *V. bakerii*, and *Civettictis civetta*. He notes the greater proportionate width of *V. durandi* between the post-orbital processes, the strong development of the temporal ridges, and the steeper inclination of the maxillæ to the horizontal plane. It has, however, escaped his notice

FIG. 1.

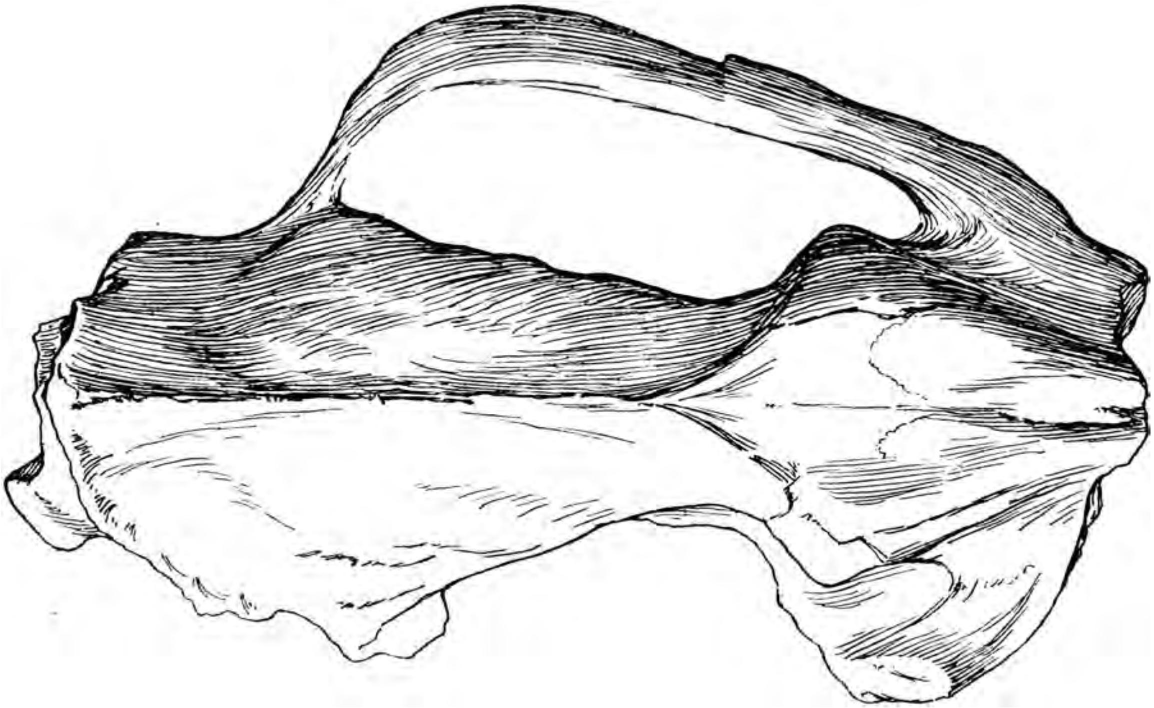
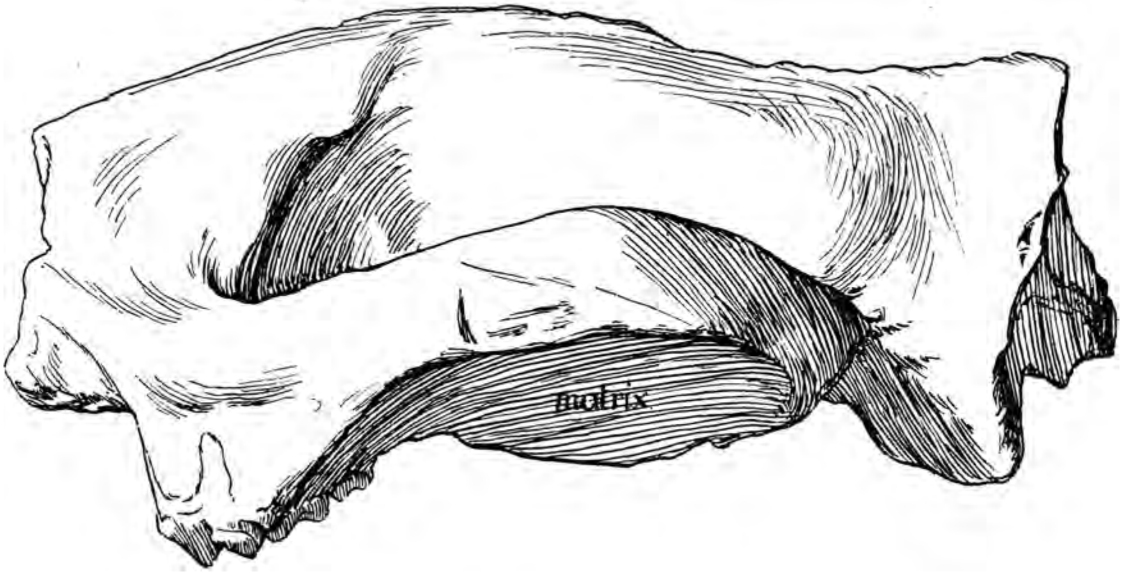


FIG. 2.



FIGS. 1 AND 2.—*Vishnuictis durandi* (Lydekker). Holotype Br. Mus. no. M 1338. Fig. 1, skull seen from above; fig. 2, skull seen from left side. Natural size.

that the height both at the muzzle and at the frontals, and the extended area of contraction between the post-orbital processes and the brain case are quite unlike any species of *Viverra.* In these features, however, as well as in the others to which Lydekker has drawn attention there is a close correspondence between the Upper Siwalik species and *Vishnuictis salmontanus* of the Dhok Pathan stage of the Middle Siwaliks. Lydekker has mentioned the great extension of the palate behind the molars as distinguishing it from *Viverra zibetha,* but not from *V. bakerii.* The preservation of the skull of *V. salmontanus* does not permit us to observe whether the palate was equally long in that species. The height of the skull and the slenderness of the muzzle seem to be less pronounced in *V. durandi* and the width at the zygomatic arches seems to be greater. In addition the upper molars lie more obliquely to the axis of P^4; M^2 has a greater transverse diameter and its outer border is in continuation of that of M^1, so that it occupies a less external position than in *V. salmontanus.* Moreover the antero-posterior diameter of P^4 exceeds that of the united M^1 and M^2, instead of being equal to it. Some of these differences are no doubt due, like its greatly superior size, to its being in a more advanced stage of development, and there seems nothing unreasonable in regarding it as the direct descendant of *V. salmontanus.*

As Lydekker has observed there is a considerable difference in size between the holotype and Br. Mus. skull no. 37150, and it is possible that the latter may belong to a local race, but seeing that they agree in all essential features of structure, we may surmise that the difference in size may be only individual, and insufficient to justify their separation.

PRIONODON (?) sp.

Lydekker has so named the fragmentary left humerus (G. S. I. No. F 229*b*) from the Billa Surgam Cave deposit, which he described and figured (1886, p. 39, Pl. vii, fig. 12).

Subfamily: *HERPESTINÆ.*

HERPESTES GRISEUS, Desmarest.

Lydekker has referred to this species a slightly imperfect skull with the associated ramus and a great part of the skeleton (G. S. I. no. F 230), and two mandibular rami (G. S. I. nos. F 230 *b* and *c*) from the Billa Surgam Cave deposit. The skull and associated remains on account of their fresh condition are considered to be of later date than the bed in which they occur. The two latter mandibular rami on the contrary belong to the proper fossil cave fauna. The skull and the associated mandibular ramus and humerus were figured by Lydekker (1886, p. 32, Pl. vii, figs. 7-9).

HERPESTES FUSCUS, Waterhouse.

Lydekker considers that two mandibular rami (G. S. I. no. F 231) figured by him (1886, Pl. vii, figs. 10, 10*a*) from the Billa Surgam Cave deposit are identical with the mandible of this species. He also figured in Pl. vii, fig. 11 a humerus (G. S. I. no. F 231*a*), which he refers to the same species.

Family : *HYAENIDÆ*

Diagnosis.—Aeluroidea with skull primitively low, progressively heightening; wide zygomatic arches; entotympanic much reduced, separated by a septum from and hidden by the large, strongly swollen ectotympanic; paroccipital process broad, adherent to the hinder wall of the tympanic bulla; mastoid process small; alisphenoid canal short, posterior opening present or absent; dentition $\frac{3}{3}$. $\frac{1}{1}$. $\frac{3 \text{ or } 4}{3 \text{ or } 4}$. $\frac{1 \text{ or } 3}{1 \text{ or } 2}$; M^1 and M^2 progressively reduced; P^4 greatly elongated, with strong parastyle and long shearing metacone, protocone large or small; M_1 with two long blades and a talonid, metaconid present or absent; I^3 and I_3 progressively enlarging; front limbs long; hind limbs long in the primitive members of the family, but progressively shortening; extremities digitigrade, manus and pes tetradactyl.

Remarks.—The genera which I include in this family are the following:—*Hyaena, Crocuta, Hyaenictis, Lycyaena, Ictitherium* and *Thalassictis* (=*Progenetta*). Lydekker united the first four of these in the single genus *Hyaena,* and even to-day some writers such as Matthew seem inclined to deny more than subgeneric rank to any of them. Zoologists have generally recognized the generic distinctness of the living *Crocuta crocuta* and *Hyaena hyaena,* and there seems little doubt that primitive species of the former are found fossil as far back as the Miocene. It might even prove convenient to split up the genus *Crocuta* still more, since the extreme reduction of the protocone of P^4 in the species *C. eximia, C. gigantea, C. variabilis, C. mordax,* and *C. carnifex* clearly delimits these from other species of *Crocuta.* This course, however, has not been taken in this work. *Hyæna* is in many ways the more primitive of the living species, through its large M^1 and the retention of the metaconid in M_1, but its ancestry is less certain. Both *Hyaenictis* and *Lycyaena* are related genera, but it is probable that neither of them is on the direct ancestral line to *Hyaena,* and that such an ancestor has not as yet been discovered. I have elsewhere (Pilgrim, 1931 pp. 80—82) discussed the question and have suggested, as an explanation of some of the problems, the hypothesis that the Hyænid centre of distribution lay in a region which palæontological investigation has not yet touched.

Lydekker and many other authors did not rank the genera *Ictitherium* and *Thalassictis* (=*Progenetta*) as Hyænid at all, but classed them with the Viverridæ. Even Winge's (1896, p. 59) contrary view was not universally accepted. I have, elsewhere (Pilgrim, 1931 p. 85) summarised and amplified Winge's arguments, which in my opinion leave no reasonable doubt that *Ictitherium,* including the genera *Palhyaena* and *Lepthyaena* into which it has often been divided, is in all respects a primitive Hyænid and that its resemblances to the Viverridæ are due, as in so many other similar cases, to the retention in both of primitive features. This naturally becomes more marked the nearer we get to the point from which the two families diverged. *Thalassictis* Gervais (1850), genotype *Mustela incerta* Gerv., is an imperfectly known genus of the Miocene, of which the exact degree of relationship to *Ictitherium* is uncertain (*see* Pilgrim, 1931, pp. 79, 83).

Measurements of Indian Fossil Hyaenidae Upper Dentition.

—		*Ictitherium sivalense* (G. S. I. no. D 124) Pl. v, fig. 4.	*Ictitherium sivalense* (G. S. I. no. D 123) Pl. v, fig. 3.	*Ictitherium* (?) sp. (G. S. I. no. D 213) Pl. v, fig. 2.	*Ictitherium indicum* (G. S. I. no. D 246) Pl. v, fig. 8.	*Hyaenictis bosei* type (Br. Mus. no. 37133) figd. in Pal. Ind. (10) II, Pl. xxxiv.	(?) *Lycyaena* cf. *proava* (G. S. I. no. D 212) Pl. v, fig. 1.	*Lycyaena macrostoma* type skull (G. S. I. no. D 44) figd. in Pal. Ind. (10) II, Pls. xxxvi, xxxvii.	*Lycyaena macrostoma* var. *vinayaki* (G. S. I. no. D 137), Pl. vii, fig. 6, 7.	*Crocuta mordax* type (G. S. I. no. D 205) Pl. vi, fig. 1.	*Crocuta carnifex* (G. S. I. no. D 173) Pl. viii, fig. 2.	*Crocuta carnifex* (G. S. I. no. D 168) Pl. vii, fig. 2.	*Crocuta gigantea* var. *latro* type (G. S. I. no. D 206) Pl. vi, fig. 2.	*Crocuta gigantea* var. *latro* (G. S. I. no. D 208) Pl. vii, fig. 13.	*Crocuta sivalensis* type Dublin Mus. no. 4, figd. in Pal. Ind. (10) II, p. 282, text fig.	*Crocuta* cf. *sivalensis* (G. S. I. no. D 46) figd. in Pal. Ind. (10) II, Pl. xxxv, fig. 5.	*Crocuta felina* type (Br. Mus. no. 15902) figd. in Q. J. G. S., Pl. vi, fig. 6.	*Crocuta* cf. *felina* (Br. Mus. no. 37138) figd. in Pal. Ind. (10) II, Pl. xxxvA, fig. 2.	*Crocuta colvini* type (G. S. I. no. D 47) figd. in Pal. Ind. (10) II, Pl. xxxv, fig. 2.	*Crocuta* cf. *colvini* (G. S. I. no. D 101) figd. in Pal. Ind. (10) II, Pl. xxxv, fig. 4.
P¹	ant. post. diam.	..	..	..	..	..	..	app. 7·5	..	..	..	..	..	..	6·1	..	..	..	..	..
	trans. diam.	..	..	..	..	..	..	5·6	..	..	..	..	..	..	..	..	..	..	..	..
P²	ant. post. diam.	..	..	15·0	..	14·5	..	app. 15·0	22·8	..	17·0	..	..	..	18·3	..	17	19·1	15·2	..
	trans. diam.	..	..	app. 6·0	..	10	..	..	13·2	..	11·7	..	..	..	..	..	..	..	..	..
P³	ant. post. diam.	..	13·4	16·9	..	20	..	app. 23·4	26·0	app. 16·5	21·2	..	app. 20	21	21·5	..	21·3	23·7	21·4	18·2
	trans. diam.	..	7·7	9·7	..	12	..	app. 12·5	15·9	app. 14·4	15·6	..	app. 18	18	..	..	..	..	..	14·7
P⁴	ant. post. diam.	21·9	20·8	..	26·3	29·5	..	app. 33·6	..	37·0	..	29·0	37·8	..	38	41·5	34·5	39·2	40	34·8
	trans. diam.	13·4	app. 12·8	..	14·8	..	..	app. 17·2	..	app. 17·3	..	16·0	17·5	..	..	app. 25	app. 21	22·5	19·8	app. 18·2
M¹	ant. post. diam.	7·7	..	..	..	7	app. 5·6	8·0	..	6·6	..	..	..	..	..	..	..	..	..	4·3
	trans. diam.	app. 12·9	..	..	..	14·5	9·5	16·8	..	14·5	..	..	..	..	..	..	..	..	..	10·7
M²	ant. post. diam.	4·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	trans. diam.	6·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
mm¹	ant. post. diam.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
mm²	ant. post. diam.	..	..	..	..	..	6·9	..	..	..	..	..	..	..	..	..	..	..	..	..
mm³	ant. post. diam.	..	..	..	..	..	13·5	..	..	..	..	..	..	..	..	..	..	..	..	..
mm⁴	ant. post. diam.	..	..	..	..	..	app. 8·8	..	..	..	..	..	..	..	..	..	..	..	..	..
	trans. diam.	..	..	..	..	..	app. 9·7	..	..	..	..	..	..	..	..	..	..	..	..	..

Measurements of Indian Fossil Hyaenidae Lower Dentition.

—		ICTITHERIUM SIVALENSE							ICTITHERIUM INDICUM.							LYCYÆNA MACROSTOMA.						CROCUTA CARNIFEX.					CROCUTA GIGANTEA var. LATRO.			
		G. S. I. no. D 38a, type, figured in Pal. Ind. (10) II, Pl. xlv, figs. 9, 9*a*.	G. S. I. no. D 38b, figured in Pal. Ind. (10) II, Pl. xlv, fig. 8.	G. S. I. no. D 125, Pl. v, fig. 7.	G. S. I. no. K 13658.	G. S. I. no. D 122, Pl. vi, fig. 5.	G. S. I. no. D 253, Pl. ix, fig. 4.	G. S. I. no. K 23744.	G. S. I. no. D 53, type, figured in Pal. Ind. (10), II, Pl. xxxviii, fig. 2.	G. S. I. no. D 210, Pl. iv, fig. 11.	G. S. I. no. K 13403.	(?) *Ictitherium indicum* (G. S. I. no. D 211) Pl. iv, fig. 12.	*Hyaenictis bosei* (Br. Mus. no. 16555) figured in Pal. Ind. (10), II, Pl. xxxviii, fig. 5.	*Lycyaena proavai*, type (G. S. I. no. D 128, Pl. v, fig. 6.	*Lycyaena chinjiensis*, type (G. S. I. no. D 233) Pl. vi, fig. 6.	G. S. I. no. D 52, figured in Pal. Ind. (10), II, Pl. xxxviii, fig. 4.	G. S. I. no. D 136, Pl. v, fig. 9.	G. S. I. no. D 138, Pl. v, fig. 10.	*Lycyaena macrostoma* var. *vinayaki* (G. S. I. no. D 139) Pl. vii, figs. 8, 9.	*Crocuta mordax*, type (G. S. I. no. D 204) Pl. vi, figs. 3, 4.	*Crocuta mordax* (G. S. I. no. D 163) Pl. vii, fig. 10.	G. S. I. no. D 172, type, Pl. vii, fig. 1.	G. S. I. no. D 171, Pl. vii, fig. 4.	G. S. I. no. D 170, Pl. vii, fig. 3.	G. S. I. no. D 169, Pl. vii, fig. 12.	G. S. I. no. D 164, Pl. vii, fig. 5.	G. S. I. no. D 231, Pl. viii, fig. 3.	G. S. I. no. D 162, Pl. vii, fig. 11.	G. S. I. no. D 209, Pl. viii, fig. 1.	*Crocuta* cf. *sivalensis* (G. S. I. no. D 102) figured in Pal. Ind. (10), II, Pl. xxxviii, fig. 1.
P_1	ant. post. diam.	..	..	..	..	..	..	app. 8·0	..	..	..	app. 10·0	..	..	..	app. 5·9	app. 6·6	app. 5·1	..	..	..	..	..	..	..	..	..	..	..	..
	trans. diam.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P_2	ant. post. diam.	..	..	app. 8·3	..	..	11·5		..	..	..	app. 17·3	14·7	..	..	app. 15·0	app. 15·2	15·5	..	16·1	..	app. 12·0	..	12·8	app. 13·8	..	app. 20·4	..	..	18·2
	trans. diam.	..	..	app. 7·0	..	..	7·0	6·5	..	..	..	..	8·5	..	..	..	..	7·8	..	10·0	..	..	..	10·3	..	..	app. 14·3	..	..	13·7
P_3	ant. post. diam.	..	app. 15·4	15·2	..	..	app. 15·4		..	..	..	15·8	19·3	..	..	20·0	19·1	20·2	22·4	app. 20·0	..	app. 16·7	16·1	16·7	18·4	..	..	..	..	25·2
	trans. diam.	..	7·0	7·7	..	..	7·8	8·4	..	..	..	9·6	11·1	..	..	11·1	11·0	10·9	11·8	app. 12·0	..	..	11·8	13·2	app. 13·1	..	..	..	..	17·2
P_4	ant. post. diam.	app. 16·6	app. 14·7	app. 15·0	..	16·0	app. 17·0	app. 16·5	20·3	..	..	..	20·9	14·2	..		23·7	..	24·9	22·3	24·0	19·8	20·7	..	..	..	..	29·5	25	28·0
	trans. diam.	app. 7·9	7·8	8·7	..	8·0	7·7	..	10·8	..	..	..	11·4	6·7	..	11·9	11·7	..	12·5	13·8	13·8	12·2	11·5	..	..	..	..	17·3	15	16·7
M_1	ant. post. diam.	app. 18·2	..	19·0	18·6	19·5	app. 19·3	..	22·8	21·7	22·8	..	22·9	15·6	16·5	app. 24·0	23·0	..	..	28·0	..	21·6	..	..	..	22·5	..	app. 29	app. 26	30·3
	trans. diam.	8·4	..	8·4	8·3	8·5	9·2	..	10·7	10·1	11·6	..	11·1	8·1	7·8	..	10·9	..	..	13·5	..	11·1	..	..	..	11·7	..	..	..	14·6
Depth of ramus below M_1		..	26·0	30·5	30·5	26·2	28·3	..	36·5	31·8	..	..	43·0	27·5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	50·8
C	ant. post. diam.	..	..	..	..	..	12·0		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	trans. diam.	..	..	..	..	..	8·1	9·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
mm_2	ant. post. diam.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	app. 12·0	..	app. 10·4	..	..	..	..	19·2	..	..	..
mm_3	,, ,,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	app. 16·4	..	app. 14·2	..	..	..	..	18·5	..	..	..
mm_4	,, ,,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	app. 20·2	..	app. 15·0	..	..	..	..	..	..	..	..

The Hyaenidae are well represented in the Indian deposits and the occurrence in that country of at any rate certain branches of the family at an earlier horizon than is the case in Europe, sheds some light on their lines of descent. The additional information, apart from the views as to the classification of *Ictitherium* which were not current at the time when Schlosser (1890, p. 415) published a diagram, which expressed his views on the evolution of the group, shows that Schlosser's diagram does not represent the facts correctly. In the diagram on plate X, I have ventured to modify it considerably, and have indicated what seem to me the most probable lines of descent of the various known species of the family. The facts on which it is based will be found scattered through the section of this work which deals with the various species of the Hyaenidae, as well as in the corresponding portion of my Catalogue of the Pontian Carnivora of Europe (Pilgrim, 1931, pp. 78—124). It must only be regarded as a provisional phylogenetic scheme subject to modification in the light of fuller knowledge in the future.

Genus : ICTITHERIUM, Wagner.

1840. *Galeotherium,* Wagner, *Abh. k. bayer. Akad. Wiss.* III, Abt. 1. p. 165, Pl. i, figs. 4—6. *Non Galeotherium* Jäger, G. F., 1839, Ueber die fossilen Säugethiere welche in Wurttemberg aufgefunden werden sind, heft II, p. 71.
1848. *Ictitherium,* Wagner, *Abh. k. bayer. Akad. Wiss.,* V, Abt. 2, p. 375.
1850. *Thalassictis,* Gervais (*ex* Nordmann MS) *pars,* Zool. et Pal. franc., 1st edition, p. 120, explanation of Pl. xxiii.
1859. *Palhyaena,* Gervais, 2nd edition, p. 242.
1884. *Lepthyaena,* Lydekker, *Pal. Ind.* (10) II, p. 312, Pl. xlv, figs. 8, 9.

Diagnosis.—Hyaenidae with narrow elongate skull; posterior opening of alisphenoid canal generally large; sagittal crest rather low; occipital low, broad, semicircular; lambdoidal crest prominent; postorbital processes prominent; premaxillae not separated from the frontals by any very appreciable interval; dentition I $\frac{3}{3}$ C $\frac{1}{1}$ P $\frac{4}{4}$ M $\frac{2}{2}$; third incisor but slightly enlarged; canine long, slender; anterior premolars long, with large posterior cusp, anterior cusp feeble or absent; P^4 with prominent protocone; M^1 large, triangular; M^2 large or small, subtriangular or oval; mandible with convex lower border; not very deep masseteric fossa; premolars with well marked anterior and posterior cusps; M_1 with large metaconid and large or moderate talonid; hind feet longer than front feet; first digit not functional; fifth metacarpal and fifth metatarsal hardly articulating with the unciform and cuboid respectively; unciform with a large dorso-plantar diameter; plantar surface of tarsus with moderately deep groove and fairly prominent processes for attachment of the peroneus longus ligament; pronounced plantar process to the unciform; peroneal ridge of the fifth metatarsal prominent and only slightly bent outward; claws partially retractiles.

Genotype.—Ictitherium viverrinum, Roth and Wagner (1854, p. 392) [=*Thalassictis robusta,* Gervais (*ex* Nordmann MS)]. I have fully discussed elsewhere (Pilgrim, 1931, p. 83) the synonymy of this genus.

Species.—I include in the genus *Ictitherium* not only the various species which were originally described under that generic designation, but also *Palhyaena hipparionum*, Gervais, *Palhyaena indica*, Pilgrim and *Lepthyaena sivalensis*, Lydekker. In uniting *Palhyaena* with *Ictitherium* I am following the procedure adopted by Gaudry (1862, p. 68), Zdansky (1924, pp. 67, 74) and Dietrich (1927, p. 364). Both the latter authors have called attention to the inconstancy of the characters relied on as a means of distinguishing these two genera, showing that where they do not actually vary locally or individually within the same species, they change by almost imperceptible stages from one species to another. *I. hipparionum* is certainly more advanced in the direction of *Hyaena* than *I. robustum*; and *I. robustum* than *I. orbignyi*, but other species serve to bridge the gulf between them, so that generic separation seems to be impracticable. In a previous work (Pilgrim, 1931 p. 99) I have summarised Zdansky's and Dietrich's observations and while adducing some additional facts relating to the structure of the feet, which bring *I. hipparionum* nearer to *Hyaena* than *I. robustum*, I have advocated the same classification as that which is adopted here.

Dietrich and still more recently Arambourg and Piveteau (1929, p. 66) have gone so far as to suggest that many of the species hitherto established are not entitled to more than varietal differentiation, and I therefore have refrained from making more than two species of *Ictitherium* out of the Indian material, all the more readily because that material is so meagre. The different specimens vary considerably amongst themselves but I think that much more complete material is needed before it is possible to estimate the real value of the variations.

In the circumstances I shall merely name the various species which have been founded from time to time. These are the following: *I. hipparionum* (Gervais, 1846, p. 248); *I. robustum* (Gervais, 1850, p. 120); *I. orbignyi*, Gaudry and Lartet (1856, p. 273); *I. sivalense*, Lydekker (1877, p. 32); *I. sarmaticum*, Pavlow (1908, p. 29); *I. indicum*, Pilgrim (1910, p. 64); *I. tauricum*, Borissiak (1915, pp. 17, 40); *I. gaudryi*, Zdansky (1924, p. 67); *I. sinense*, Zdansky (1924, p. 72); *I. wongii*, Zdansky (1924, p. 73); *I. hyaenoides*, Zdansky (1924, p. 84). The species *Palhyaena proava*, Pilgrim (1910, p. 65) is here included in the genus *Lycyaena* (page 130).

Remarks.—Gaudry (1862, pp. 52—65), although recognizing that in many characters the genus *Ictitherium* approached the Hyaenidae, while in others it occupied an intermediate position between that family and the Viverridae, yet chose to classify with the latter, in which he was followed by Schlosser (1891, p. 399); Schwarz (1912, p. 72); Borissiak (1915, pp. 17, 40); Zdansky (1924, p. 67); Dietrich (1927, p. 364); Arambourg and Piveteau (1929 p. 120) and others. Winge (1895, p. 59) pointed out that in regard to the structure of the auditory bulla *Ictitherium* was definitely allied to the Hyaenidae rather than to the Viverridae. His view has been adopted by Abel (Weber 1928, p. 323) and Matthew (1929, p. 493). I have discussed the whole question and summarised the evidence in a previous work (Pilgrim, 1931, pp. 85, 86). It is, therefore, unnecessary to enter further into it here.

ICTITHERIUM SIVALENSE, Lydekker.

(Pl. V, figs. 3, 4, 7 ; Pl. VI, fig. 5 ; Pl. IX, fig. 4.)

1877. *Ictitherium sivalense*, Lydekker, *Rec. Geol. Surv. Ind.* X, p. 32.

1884. *Lepthyaena sivalensis*, Lydekker, *Pal. Ind.*, (10), II, p. 312, Pl. xlv, figs. 8, 9.

Diagnosis.—An *Ictitherium* intermediate in size between *I. robustum* and *I. hipparionum* and approximately equal to *I. wongii* ; with ramus considerably deeper than the length of M_1 ; M_1 relatively long ; talonid about two-fifths the length of the trigonid ; metaconid of moderate height ; M_2 smaller and less elongate than in *I. wongii* ; lower premolar series shorter relatively to M_1, than in *I. wongii* ; P_3 and P_4 with weaker anterior accessory cusps ; outer line of upper molars lying at an angle of 60° with the outer edge of P^4 ; M^1 with antero-posterior less than two-thirds of the transverse diameter ; M^2 oval in shape, somewhat extended transversely, antero-posterior and transverse diameters less than half those of M^1 ; P^3 relatively short with weak anterior accessory cusp and broad internal cingulum ;—

Lectotype.—The present species was founded by Lydekker (1877, p. 32 ; 1884, p. 312, Pl. xlv, figs. 8, 9, 9*a*) on two fragments of a left and right mandibular ramus respectively, which he considered to belong to the same individual. This is hardly likely since P_4 in the left ramus is distinctly longer than the same tooth in the right ramus, nor are they certainly in the same stage of wear. In the circumstances I choose the left ramus figured in Pl. xlv, figs. 9, 9*a* as the holotype of the species. It is in the collection of the Geological Survey of India regd. no. D 38*a*. The other specimen G. S. I. no. D 38*b* is then the paratype.

Referred specimens.—A left mandibular ramus (G. S. I. no. D 125) from Dhok Pathan figured in Pl. v, figs. 7, 7*a*, 7*b* of this work.

A fragmentary left ramus (G. S. I. no. D 122) from Haritalyangar, Simla Hills figured in Pl. vi, figs. 5, 5*a*, 5*b* of this work.

A fragmentary left ramus (G. S. I. no. K 13, 658) containing M_1 and the alveolus of M_2 from Dhurnal, Attock district.

A fragment of the right mandibular ramus (G. S. I. no. K 23, 744) containing the perfect P_2 and P_3 and the roots of the canine, incisors, P_1 and P_4 collected by K. Aiyengar from two miles S. W. of Kamlial in the Attock district.

A mandible (G. S. I. no. D 253) collected by H. M. Lahiri from Ahmdal, close to Khaur oilfield in the Attock district containing the entire series of teeth, but with the crowns considerably broken. This is figured in Pl. ix, figs. 4, 4*a*.

A left maxilla (G. S. I. no. D 123) containing P^3 and P^4 from Hasnot figured in Pl. v, figs. 3, 3*a*, 3*b*.

A left maxilla (G. S. I. no. D 124) containing P^4, M^1 and M^2, from Hasnot figured in Pl. v, figs. 4, 4*a*, 4*b*.

Other more imperfect specimens referable to this species have been collected at various times from the Salt Range area. Much more doubtful is a fragment of the left maxilla (G. S. I. no. D 213) containing P^2 and P^3 collected in the same locality as the other two maxillae. This is figured in Pl. v, figs. 2, 2*a*.

Locality.—The type locality is Hasnot, Salt Range. Referred specimens have also been recorded from Dhok Pathan, and Ahmdal in the Salt Range area and from Haritalyangar in the Belaspur State, Simla Hills.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description.—The holotype and paratype were described by Lydekker (1884, p. 312) with as much exactitude as their poor state of preservation permitted, and their study afresh by myself affords no facts of any value which have not been already stated. The additional specimens collected since then give us considerably more knowledge of the species, and serve amply to confirm both of Lydekker's two important conclusions; his original one that it belonged to *Ictitherium* and his second one that it was *Hyaenid.* His later attribution of it to a new genus seems to be contradicted by the evidence of the *Ictitherium* material which has accumulated since Lydekker's day, and especially of that which Zdansky has described from China (Zdansky 1924, pp. 67-91).

The ramus (G. S. I. no. D 125) agrees well enough with the holotype to justify the reference. The ramus is even deeper than in the holotype, but is shallower than *I. hyaenoides*, Zdansky. M_1 is relatively longer than in most other species; the talonid is less than one-third the entire length of the tooth and about two-fifths the lengths of the trigonid. It consists of three cusps, of which the hypoconid is elongated antero-posteriorly and joins the protoconid, the entoconid is more pointed and separated from the metaconid, while the hypoconulid is smaller and median, behind the other two. The metaconid is moderately strong, though lower than the protoconid and does not lie far behind it. There is an external cingulum. P_4 is not very well preserved anteriorly, but seems to be shorter than in the holotype, though slightly longer than in the paratype. There appears to be no anterior cusp. A strong posterior cusp is present, a broad internal cingular shelf and a posterior cingulum, the structure closely resembling P_4 in the holotype and paratype. P_3 is broken behind; there is no anterior cusp. P_2 is a double-rooted tooth known only by its alveoli in D 125 but well preserved in the paratype and in the mandible D 253. In both the latter specimens it is an elongate oblong tooth with a high, pointed main cusp, having rather sharp anterior and posterior keels, a small posterior cusp with a broad internal hollow cingular shelf and a slight cingulum at the antero-internal corner, but without a definite anterior accessory cusp. It seems to be almost identical with P_2 in *I. wongii*, Zdansky. There is a small diastema between P_2 and the one-rooted P_1 and a longer diastema of about five mm. between P_1 and the canine. Relative to the length of M_1 the premolar series is shorter than in *I. wongii* or *I. hyaenoides*. In the case of a mandible provisionally referred to *I. hipparionum* by Gaudry (1862 p. 72) the difference seems to be but trifling.

In D. 125 only the hinder part of the alveolus of the canine is shown, but in D 253, the entire cross-section can be seen. This is elongately oval, not more markedly convex on the inner than on the outer side. Its antero-posterior diameter is the same as that of P_3. The crown is badly preserved and keels are indistinctly shown. The only specimen in which the incisors are at all preserved is D 253, and even in this they are only known by their roots, the crowns being entirely broken off. They form a slightly convex border in continuation of the front edges of the canines. I_1 is much the smallest of the three and is rather compressed. I_2 is slightly displaced backward out of the row and has an oval root. I_3 is only slightly larger than I_2, the excess being accounted for by its greater antero-posterior diameter and its slightly greater lateral diameter in front, since the root tapers behind to a smaller size than that of I_2. There is a diastema of only one mm. between I_3 and the canine. The symphysis is rather flat and descends very gradually at first and then almost vertically on a level with the front end of P_3. The situation of the mental foramina is not the same in the two rami of D 253 ; on the left side there is a large one under P_3 and a smaller one under the front half of P_4, both being on the same horizontal level as is the case in the ramus D 125 ; on the right side both the foramina are large and the hinder one of the two lies very distinctly above its companion. The depth of the ramus is less in this specimen than in D 125 although the length of P_4 is considerably greater. In the holotype, in which P_4 is almost as long as in D 253, the depth of the ramus is still less and the antero-posterior diameter of M_1 is less than in either of the other two. The beginning of the coronoid process and of the messeteric fossa are shown in D 253. The former ascends rather steeply and the latter is wide but rather shallow. The lower border behind M_2 is more abruptly notched than in D 125. M_2 is represented by a small circular root in D 253 and also in K 13, 658. The other rami are insufficiently preserved to show it. Both P_3 and P_4 are longer in D 253 than in D 125 and the distance between the canine and M_1 is greater, but is all the same shorter relatively to the length of M_1 than in *I. wongii* or *I. hyaenoides.* The ramus in D 253 is slightly more stoutly built than in the holotype or in D 125, at any rate in its anterior part near the symphysis.

Upper dentition.—The two left maxillæ (D. 123 and D. 124) collected by Vinayak Rao from the Dhok Pathan stage of Hasnot obviously belong to the genus *Ictitherium* in its broad sense. One of these contains P^4, M^1 and M^2 and the other P^3 and P^4. These teeth are almost unworn and display the structure admirably. They are both of them slightly too small for any of the rami mentioned above, but since their dimensions do not lie outside the limits of individual variation and since in regard to their characters they seem to fill a place between the two Chinese species *Ictitherium wongii* and *I. hyaenoides*, which is also the case with the rami, it seems unnecessary to refer them to another species than *Ictitherium sivalense.* As will be seen from the measurements tabulated on page 110 P^4 is absolutely smaller than either of the two Chinese species, but its relative dimensions are similar ; the paracone is the highest of the three cusps of the blade, but is about the same length as the metacone. The parastyle is shorter and has a small cingulum in front of it. The protocone is well developed, its cusp being only a little shorter than the parastyle ; it lies well to the inside of the parastyle and as far forward ; its transverse diameter is greater than in most species of *Ictitherium.* There is a strong basal cingulum on the inner side of the blade, but this cannot be distinguished on the outer side. P^3 has a distinct posterior cusp and an inner cingular shelf better marked than in *Hyaena.* The anterior cusp is very minute. M^1 is almost as large relatively as the corresponding tooth in *Ictitherium wongii* and very similar in shape to that tooth both in the Chinese species and *I. hipparionum,* the transverse exceeding the antero-posterior diameter by more than one-third, and so differing from *I. robustum, I. gaudryi* and *I. sinense,* and still more so from *I. orbignyi*; it has the same three well marked main cusps and a prominent parastyle which is slightly broken. There is an anterior and posterior cingulum, but this does not continue on the inner side. It is relatively larger than in *Ictitherium hyaenoides.* The structure of M^2 seems to be very similar to that of the corresponding tooth in *I. wongii;* the three main cusps are quite distinct, there is no parastyle; the ridges connecting the protocone to the paracone and metacone are prominent and enclose a deep basin. Its shape approaches that of a regular oval. It is rather smaller than M^2 in *I. wongii* but larger than that of *I. hyaenoides.* It agrees in relative size with *I. hipparionum,* but is much smaller relatively than in *I. robustum.* The two upper molars are situated rather more to the rear of P^4 than in *I. hyaenoides* and in this respect their position is more like that in *I. wongii.* The angle between their outer borders and that of P^4 is 60°. In the holotype of *I. hipparionum* this angle is 90°, while in *I. robustum,* it is even less than 60°. According to Zdansky (1924, p. 78) this angle cannot be regarded as constant for the same species.

From the same spot as the two maxillæ just described Vinayak Rao obtained a fragment of the left maxilla with P^2 and P^3 (G. S. I. no. D 213) figured in Pl. v, figs. 2, 2a. Whether this belongs to the same individual as D. 124, the larger of the two other maxillae, is uncertain; in any case P^3 differs from the corresponding tooth in D. 123 not only in its larger size, which accords with the longer P^4 in the type mandible, but also in the exceedingly strong development of the postero-internal cingular shelf; this is much broader than in *Ictitherium hyaenoides,* the only species which at all approaches it in this respect. P^2 is also an exceedingly long and slender tooth. It is indeed not impossible that this specimen may belong to an altogether different genus from *Ictitherium.*

Remarks and comparisons.—I can hardly doubt that all the remains described above belong to a single genus, except perhaps G. S. I. no. D 213, and that this genus cannot be distinguished from *Ictitherium* in the broad sense in which it is here used. Since, however, Lydekker (1884, p. 312) has expressed a contrary view it will be necessary to consider his reasons for holding it. On comparing the holotype of *Lepthyaena sivalensis* with *Ictitherium,* that is presumably with the three species then known: *I. orbignyi, I. robustum* and *I. hipparionum,* he found that it differed in the following respects (1) in the shorter M_2; (2) in the shorter talonid of M_1; (3) in the inferior length of M_1 relative to P_4; (4) in the deeper ramus. These differences he considered to be of generic value. Not only do the additional specimens referable to the species, which have been found in India since Lydekker wrote his description, considerably discount the value of the features mentioned, but numerous species of *Ictitherium* found in China (Zdansky 1924) as well as in Europe serve to bridge over the interval which separates the Indian species from the types of *Ictitherium robustum* and *I. hippa* *rionum.* *Ictitherium hyaenoides*, Zdansky, while possessing skull characters which clearly show that it is an *Ictitherium*, has an even shorter talonid in M_1, quite as short an M_2 and quite as deep a ramus as we see in the present species. Moreover in the other specimens in which M_1 is better preserved than in the type it is clear that the talonid of M_1 does not differ very appreciably either in size or structure from what is the case even in specimens referred to *Ictitherium hipparionum* and in *Ictitherium wongii*, so that it seems possible that its length has been underestimated in the type of *Ictitherium sivalense* or else that that specimen is abnormal. The same is probably the case in respect to the apparently elongated P_4 of the type. With regard to the other differences there is such a gradual transition from a form like *Ictitherium robustum* to *Ictitherium hyaenoides* that it is quite impracticable to draw a generic boundary. Schlosser and Zdansky have come to the same conclusion. *Ictitherium sivalense* falls into its place as not even the most extreme member of the series.

Lydekker stated that the resemblances to the hyaenas were closer than to *Ictitherium*, but the comparisons which he made were with a ramus from Hasnot, which he referred to *Hyaena sivalensis* (=*Hyaenictis bosei*) (1884, Pl. xxxviii, fig. 2), which I consider is much more appropriately referred to the genus *Ictitherium*, and with another ramus from the Siwalik Hills (1884, Pl. xxxviii fig. 5) which may belong to the skull of *Hyaenictis bosei* but in which M_2 is minute. The resemblances to *Lycyaena macrostoma* are greater, but in that species there is no M_2 and the M_1 is distinctly shorter. The true *Hyaena* differs even more widely.

It is possible that some palaeontologists might consider that one species is insufficient to contain all the remains described above, but I do not consider that the material at my disposal up till now is perfect enough to make a specific separation practicable ; it would in any case be impossible to decide with which, if any, of the mandibles the maxillae should be associated. The mandibles seem to be slightly smaller than the average of *I. wongii* and considerably smaller than *I. hyaenoides*, while the upper carnassial is smaller than either of the species named. *Ictitherium hipparionum*, judging by the maxilla which is the type of the species, is larger than *I. wongii* and is only approached by the largest individuals of *I. hyaenoides.* On the other hand the mandible from Pikermi which Gaudry (1862, p. 72) doubtfully referred to *I. hipparionum* agrees well with *I. wongii.* The mandible from Maragha described by Kittl (1887, p. 333, Pl. xv, fig. 3 ; Pl. xviii, figs. 2-7) under the name of *Palhyaena hipparionum* is bigger than *I. wongii* and corresponds with Gervais' type maxilla of *I. hipparionum.* On the contrary the associated skull and mandible of *Palhyaena hipparionum* from Samos described by Schwartz (1912, p. 72) is smaller than the type maxilla and is even smaller than the Pikermi mandible mentioned by Gaudry as well as than *I. wongii.* In size the Samos skull is intermediate between the Indian mandibles and the Indian maxillae. The rich *Ictitherium* material which Zdansky (1924, pp. 67-91) has examined from China, including the remains of some 60 individuals of *I. wongii* and 30 of *I. hyaenoides*, would make it appear that size above everything is very variable in the same species, but that even the relative dimensions of individual teeth and other characters also tend to vary. The Indian specimens belonged to animals which were considerably inferior in size to *I. hipparionum* type and *I. hyaenoides*, but so far as *I. wongii* is concerned the differences in size do not appear to be outside the limits of individual variation. Since, however, this does not apply to many other charaçters, which the Indian specimens share in common with one another and in which they seem distinctly to differ from hitherto described species, such characters will now be briefly considered.

So far as concerns the mandibles, their depth and the small size of M_2 suggest an affinity with *I. hyaenoides* rather than with any other species. Most of them with the possible exception of the type ramus differ from *I. hyaenoides* in the shorter P_4 relatively to M_1 and in the longer talonid of M_1. In both these two latter characters they seem to differ also from *I. hipparionum* but to agree with *I. wongii.* In the case of *I. robustum* and *I. gaudryi* the talonid of M_1 is even longer. As has been remarked, the united length of P_2-P_4 is relatively to that of M_1 less than in any species except the ramus from Pikermi referred to *I. hipparionum.*

In the case of the maxillae the protocone of P^4 is situated more internally than in *I. wongii, I. hyaenoides* and *I. hipparionum*, and resembles *I. robustum.* M^1 and M^2 are relatively larger than in the type of *I. hipparionum* or than in *I. hyaenoides* and are situated more to the rear of P^4. M^2 in particular has the three cusps better marked. Both *I. gaudryi* and *I. sinense* belong rather to the type of *I. robustum* in this as in other characters. The differences from *I. wongii* are very trifling in regard to both the structure and position of M^1 and M^2. P^3 is a slighter tooth than in *I. hipparionum, I. wongii* and *I. hyaenoides,* and approaches *I. robustum*; it has a somewhat greater development of the internal cingular shelf than in *I. wongii* or *I. hipparionum* and more resembles *I. hyaenoides*; its length relatively to the carnassial is greater than in *I. wongii* and *I. hyaenoides* and only slightly less than in *I. hipparionum.*

It will be apparent that both the rami as well as the maxillæ here described are on the whole closer to *I. wongii* than they are to either *I. hipparionum* or *I. hyaenoides,* but that in regard to certain features they resemble *I. hipparionum* while in others they resemble *I. hyaenoides* especially in the case of the rami. Both rami as well as maxillae are therefore entitled to be considered as specifically distinct from other described species, but whether the maxillae should be separated specifically from some or all of the rami it seems impossible to decide and until further associated material comes to hand I prefer to unite them. This species together with the succeeding one are the most common of the Carnivora met with in the Middle Siwaliks except *Lycyaena macrostoma* and *Sivaonyx bathygnathus.*

ICTITHERIUM INDICUM, Pilgrim.

(Pl. IV, figs. 11, 12 ; Pl. V, fig. 8.)

1884. *Hyaena sivalensis* (*pars*) Lydekker, *Pal. Ind.*, (10), II, p. 306, Pl. xxxviii, fig. 2 ; Pl. xxxix, fig. 5.

1910. *Palhyaena, indica,* Pilgrim, *Rec. Geol. Surv. Ind.*, XL, p. 64.

1913. *Palhyaena* cf. *hipparionum,* Pilgrim, *Rec. Geol. Surv. Ind.,* XLIII, pp. 282, 289.

Diagnosis.—An *Ictitherium* of larger size than *I. sivalense* and approximately equal to *I. hipparionum,* with ramus considerably deeper than the length of M_1, rather deeper than in *I. sivalense* and about as deep as in *I. hyaenoides ;* M_1 relatively long, talonid short, only one-third the length of trigonid; metaconid low; M_2 very short; premolar series even shorter relatively to M_1 than in *I. sivalense* and much shorter than in *I. hyaenoides ;* P_4 with rather strong anterior accessory cusp; P^4 with parastyle weaker than in *I. sivalense ;* protocone less wide transversely.

Holotype.—The fragmentary right mandibular ramus described and figured by Lydekker (1884, p. 306, Pl. xxxviii, fig. 2; Pl. xxxix, fig. 5) under the name of *Hyaena sivalensis,* Bose. This is in the collection of the Geological Survey of India in Calcutta regd. no. D 53. It was the only specimen of which a figure existed at the time when the species was established and was definitely referred to by myself in the paper quoted (Pilgrim 1910, p. 64). Matthew (1929, p. 493) and I myself (Pilgrim, 1910, p. 64) are mistaken in quoting a maxilla as the holotype of the species. The only upper teeth of the species known are the two specimens of P^4 mentioned below, one of which is figured in Pl. v, fig. 8 of the present work.

Referred specimens.—A left ramus with M_1 and the alveolus of M_2 (G. S. I. no. D 210) from Hasnot figured in Pl. iv, figs. 11, 11*a* of the present work.

An isolated left M_1 also from Hasnot (G. S. I. no. K 13, 403).

A right P^4 (G. S. I. no. D 246) from Mithrala figured in Pl. v, figs. 8, 8*a*, 8*b* of this work.

A left P^4 (G. S. I. no. K 15, 790), lacking most of the metacone, from Bhandar, near Hasnot.

A fragmentary right mandibular ramus with P_4 and the roots or alveoli of M_1, P_{1-3} and the canine (G. S. I. no. D 211) from Nila figured in Pl. iv, figs. 12, 12*a* of the present work.

Locality.—The type locality is Hasnot, Salt Range. Referred specimens come in addition from Bhandar, Mithrala and Nila, all in the Salt Range area.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description.—Lydekker in describing the holotype did not always state whether his remarks referred to it or to the Siwalik Hills ramus of '*Hyaena sivalensis*' (=*Hyaenictis bosei,* Matthew). I shall therefore redescribe it, where necessary. The ramus is exceptionally deep, more than half as deep again as the length of M_1. The talonid of M_1 is too broken to see the structure clearly, but the outline shows that it was relatively short as compared with most species of *Ictitherium,* only one-third the length of the trigonid. The metaconid is low and stands well behind the protoconid. M_2 is represented by a small subcircular alveolus. P_4 is only slightly shorter than M_1; it has a strong posterior accessory cusp with a prominent postero-internal cingulum and a weaker, but still very pronounced anterior accessory cusp.

The referred specimens D 210 and K 13, 403 agree exactly with the holotype as regards the length of M_1, the dimensions of the trigonid and talonid and the height and position of the metaconid and also in the size and shape of the alveolus of M_2. The depth of the ramus is, however, somewhat less. The talonid shows the three cusps which are characteristic of *Ictitherium.* The hypoconulid is well marked, though smaller than the other two, and lies midway behind them.

The P^4 (G. S. I. no. D 246) has the typical structure of that tooth in *Ictitherium* and corresponds in size with the rami. The parastyle is strong, though weaker than the paracone. The metacone is as long as the paracone but lower. The protocone is less extended transversely than in *I. sivalense* and agrees with *I. hipparionum* as well as with *I. wongii* and *I. hyaenoides.* The right ramus from Nila (G. S. I. no. D 211) agrees in size with the type ramus from Hasnot, but its reference to the same species is extremely problematical. It differs from *I. hyænoides* as well as from *Ictitherium sivalense* in the small size of P_3 and in the large size of P_1 and P_2. P_1 is probably double-rooted. The chin slopes down from the bases of the incisor crowns to the lower border of the ramus at a much steeper angle than in the case of *Ictitherium sivalense* and most other species of *Ictitherium,* while the lower border of the ramus bends down slightly where it meets the symphysis.

Remarks and comparisons.—It will be appropriate first to consider the reasons which lead me to doubt the validity of Lydekker's attribution of the holotype to the same species as the ramus from the Siwalik Hills (Br. Mus. no. 16555) referred to *Hyaenictis bosei,* Matthew (=*Hyaena sivalensis,* Bose, *emend* Lydekker). Lydekker, apparently, entertained no doubts that the geological horizon of the two specimens was essentially the same. It is, however, now certain that while the Hasnot deposit belongs to the Dhok Pathan stage and is therefore Pontian (Lower Pliocene) the other ramus as well as the type skull of *Hyaenictis bosei* is no older than the Pinjor zone (Upper Pliocene). This circumstance alone would render it somewhat anomalous were the two to prove to be specifically the same. Unfortunately the two rami are hardly comparable in the most crucial characters, since the molar and the two hinder premolars of the Siwalik Hills specimen are in an advanced stage of wear, while the front of the jaw is lacking in the Hasnot ramus. Consequently we have only the general correspondence in size between M_1 and P_4 in the two rami in support of identity. In the Hasnot ramus M_1 has a metaconid, a talonid and an antero-external cingulum which agree in every detail with those of the genus *Ictitherium* and especially the species *I. sivalense* and *I. hyaenoides,* while M_2 was clearly present. On the other hand it cannot be claimed that M_1 of the Siwalik Hills ramus has a metaconid. Personally I am of opinion that it has not, because I can see no trace of any fold which presumably a metaconid, evenetel if worn away, would leave, but in any case it could only have been rudimentary. Lydekker's first impression (1884, p. 306) that M_2 was absent in *Hyaenictis bosei* was corrected later (1885, p. 90). That tooth is, however, the minutest rudiment in *H. bosei,* whereas in *Ictitherium indicum* it was almost as large as in many other species of *Ictitherium.* The talonid of M_1 is also shorter than in the Hasnot ramus. Further the depth of the ramus is greater. In the Hasnot ramus there is a marked notch in the lower border behind M_1. This is a feature of the genus *Ictitherium*, whereas the curvature in the Siwalik Hills ramus is more gradual.

There is no reason to separate the Hasnot ramus from *Ictitherium*. Of the described species it is closer to *Ictitherium hyaenoides* both on account of the small size of M_2 as well as by the depth of the ramus; in the ramus (G. S. I. no. D 210), which was formerly thought by the writer to be *Palhyaena hipparionum*, this dimension seems to be greater than in most of the specimens of the Chinese species, but Zdansky's measurements show that it is subject to considerable variation. A difference from *I. hyaenoides* seems to exist in the rather longer P_4 of the Indian species and also, if the reference of the Nila ramus (G. S. I. no. D 211) to this species is correct, in the much larger P_1 and P_2 and the smaller P_3. The two species, however, agree in size and the difference between them may in some measure be due to individual variation. *I. indicum* is larger than *I. sivalense* and still larger than the maxillæ (D. 123 and 124) which have been provisionally referred to that species.

Genus : HYÆNICTIS, Gaudry.

1861. *Hyaenictis, Gaudry, C. R. Acad. Sci. Paris*, LII, p. 722; *Bull. Soc. Geol. France*, (2), XVIII, p. 527.

Diagnosis.—Hyaenidae with moderately long, slender, rather shallow mandible and (by inference) with somewhat elongated facial region; M^1 large, triangular, almost at right angles to P^4; M^2 absent; P^4 with long posterior lobe and large protocone; M_1 short, hardly longer than P_4, without metaconid; M_2 small; P_1 present but with a tendency to be deciduous; P_2 with large posterior and small anterior cusp; P_3 with large posterior and small anterior cusp; P_4 with large anterior and posterior cusps.

Genotype.—Hyaenictis graeca Gaudry (1861, p. 527, Pl. xi, figs. 1, 2).

Species.—The genotype is the only species which can definitely be referred to the genus. There seem, however, some grounds for regarding the species *Hyaena bosei*, Matthew from the Upper Siwaliks of India as a species of *Hyaenictis*.

HYÆNICTIS BOSEI, Matthew.

1868. *Felis cristata* (*errore*), Falconer, Pal. Mem. I, Pl. xxv, figs. 1-4; II, p. 548.

1880. *Hyaena sivalensis*, Falc. & Caut. *emend.* Bose *pars*, *Quart. Journ. Geol. Soc. London*, XXXVI, p. 128.

1884. '*Hyaena sivalensis* Bose', Lydekker, *Pal. Ind.*, (10), II, p. 303, Pl. xxxiv.

1929. *Hyaena* (*Hyaenictis*) *bosei*, Matthew, *Bull. Amer. Mus. Nat. Hist.*, LVI, p. 493, fig. 28.

Diagnosis.—A *Hyaenictis* of somewhat smaller size than *Hyaenictis graeca*; M^1 situated posteriorly to P^4; P^4 with parastyle equal in size to paracone, protocone mainly opposing parastyle and only very slightly paracone; M_2 smaller than in *Hyaenictis graeca*; M_1 with metaconid either absent or rudimentary; lower premolars with anterior accessory cusps absent or at any rate much weaker than in *Hyaenictis graeca ;* P_1 absent.

Holotype.—The skull figured in Falconer, Pal. Mem. I, Pl. xxv, figs. 1-4 under the name of *Felis cristata* (in error), described by Bose (1880, p. 128) and subsequently described and refigured by Lydekker (1884, p. 303, Pl. xxxiv). It is preserved in the British Museum regd. no. 37133.

Nomenclature.—Lydekker seems to have regarded the name *Hyaena sivalensis* Falconer and Cautley as a *nomen nudum* and as such considered himself justified in disregarding it, adopting the name *Hyaena sivalensis,* Bose for the skull figured for the first time in the Palaeontological Memoirs. Matthew, however, pointed out (1929, p. 491) that even if *Hyaena sivalensis,* Falc. et. Caut. were a *nomen nudum,* its previous use for a hyaena invalidated a subsequent application of it to another hyaenid species. Matthew, therefore, proposed the name *Hyaena* (*Hyaenictis*) *bosei* for the present species. Incidentally it may be mentioned here, as Matthew (1929, p. 489) has clearly explained (*see also* below p. 135), that the name *Hyæna sivalensis,* Falc. et Caut. is not a *nomen nudum* but is based on a skull described and figured by Baker (1835, p. 569, Pl. xlvi, figs. 22, 23).

Referred specimens.—Two specimens of the skull, preserved in the British Museum (nos. 37136 and 37134) and mentioned by Lydekker (1884, p. 306). A left mandibular ramus figured by Lydekker (1884, Pl. xxxviii, fig. 5 and Pl. xxxix, fig. 7) ; it is in the British Museum (No. 16555).

Locality.—Both the holotype and the referred specimens belong to the Cautley collection from the Siwalik Hills, the exact place in which they were found being unknown.

Horizon.—There is no reason to infer that the specimens were derived from a horizon different from that from which the bulk of the Siwalik Hills fossils were obtained. This I believe to be the Pinjor stage of the Upper Siwalik.

Description and comparisons.—The holotype and referred skulls of this species have already been described by Lydekker (1884, pp. 304-306) and only certain special points need to be called attention to or emphasised. Although the skull is less slender than that of *Lycyæna macrostoma,* yet it is more slender than that of *Hyaena hyaena,* and much more so than any known skull of *Crocuta.* The elongation is particularly noticeable in the facial region. The brain case is narrower than in *Hyaena hyaena,* and the width of the zygomatic arches is probably less. At any rate the temporal foramina are more elongate than in species of *Hyaena* and *Crocuta.* The post-orbital processes are exceptionally long. This is well shown in the British Museum referred skull No. 37136. This character is reminiscent of *Ictitherium orbignyi* and *robustum* No. 37136 shows the maxillary sutures well while the other skulls show the nasal sutures. It thus becomes clear that the nasals terminated far in advance both of the orbit and of the hinder end of the maxilla. This is a feature not found in *Hyaena hyaena,* but is on the contrary characteristic of *Ictitherium robustum.* M^1 has a much greater antero-posterior diameter than that of any known species of *Hyaena* or *Crocuta.* Both in size and shape it agrees with M^1 of *Hyaenictis graeca,* and more significant still, it lies posteriorly to P^4, much more so than in *Hyaenictis graeca.* This character recalls in some degree the position of the upper molars in *Ictitherium.* The weakness of the anterior cusps of the anterior upper premolars is very different from what we find in *Hyaena hyaena* but agrees better with *Hyaenictis graeca.* It also agrees with the European species in the equality in size of the paracone and metacone in P^4 but the parastyle is much longer in *H. bosei*; and the protocone in P^4, which in *Hyaenictis graeca* opposes the paracone for half the length of the latter cusp, in *H. bosei* extends but little backward of the parastyle.

Mandible.—The referred mandible (Br. Mus. no. 16555) is mentioned and figured by Lydekker (1884, p. 306, Pls. xxxviii, fig. 5 and xxxix, fig. 7) but since his description is largely a composite one based not only on the specimen from the Siwalik Hills but also on another (G. S. I. no. D 53) from the Dhok Pathan stage of Hasnot, it is difficult to apply it with certainty. The latter specimen has already been referred to the genus *Palhyaena* with the specific name of *indica* (Pilgrim 1910, p. 64) and is described above under the name of *Ictitherium indicum* (p. 119). The teeth in the Siwalik Hills specimen (Br. Mus. no. 16555) are unfortunately in an advanced stage of wear, but the extreme slenderness of the jaw invites a reference to the same species as the holotype skull, which is also slender. Added to the fact that both the skull and the mandible possess characters which seem only to be paralleled in the species *Hyaenictis graeca*, there seems to be some ground for the attribution. The mandible belonged to a somewhat larger individual than the skull. Although Lydekker did not mention the presence of M_2 in his first description, he subsequently discovered the broken root of a minute M_2, which he refers to in a later work (Lydekker, 1885, p. 90). That author apparently had no doubt that M_1 in the ramus No. 16555 had a metaconid, but I personally incline to the opinion that it had not, though I grant that the advanced wear of the crown admits of a doubt on the point, but in any case it could only have been rudimentary. The presence of M_2 and the absence of a metaconid in M_1 were the characters chiefly relied upon by Gaudry in separating *Hyaenictis* as a genus. Differences from *Hyaenictis graeca* are to be seen in the apparent absence or at any rate considerable reduction of the anterior accessory cusps in $P_{2\text{-}4}$.

Remarks.—Lydekker clearly recognized the affinity between *Hyaenictis graeca* and *bosei* but did not consider either generically separable from *Hyaena.* Trouessart (1898, p. 320) actually went the length of putting *H. bosei* as merely a race of *H. graeca.* Apart from the improbability of a Pontian species persisting into the Pinjor stage, which is at least as young as Upper Pliocene, the differences between the European and the Indian species mentioned above seem to be fully sufficient on which to base two distinct specific diagnoses. Matthew came to the same conclusion. On the material available there is little sign of a greater degree of modernisation in the Indian species than in the European one, except in the loss of P_1 and of the anterior cusps of the lower premolars. In fact in some ways *H. bosei* is more primitive than *H. graeca,* as for example in the position of M^1 and the possible retention of a metaconid in M_1. The Siwalik species can not therefore be regarded as a descendant of the Pontian one. A lineal ancestor of the former may have existed in the Dhok Pathan stage, but in any case it seems likely that both the known species owe their presence in Europe and India respectively to migration from a centre of distribution as yet undiscovered.

Genus : Lycyæna, Hensel.

1861. *Hyaena pars* Gaudry, *Bull. Soc. Geol. France,* (2), XVIII, p. 534.
1833. *? Agnotherium,* Kaup, Oss. foss. Darmstadt. pt. 2, p. 28.
1861. *? Agnocyon,* Kaup, Urweltliche Säugethiere, pt. 5, p. 16.
1862. *Lycyaena,* Hensel, *Monatsber. k. Preuss. Akad. Wiss. Berlin,* p. 567.

Diagnosis.—Hyænidæ with narrow, elongate skull; occipital of medium height, not markedly triangular, narrow below; sagittal crest rather low; lambdoidal crest moderately prominent; orbit rather large; post-orbital processes not very prominent; premaxillæ separated by an interval from the frontals; dentition I $\frac{3}{3}$ C $\frac{1}{1}$ P $\frac{4}{3 \text{ or } 4}$ M $\frac{1}{1}$; third incisor somewhat enlarged; canine large; anterior premolars in a straight line, generally well spaced (slightly overlapping in *L. lunensis*), long, with large posterior and practically no anterior cusp; P^4 with prominent protocone; M^1 rather large, transverse to P^4 but slightly behind it; mandible with deep masseteric fossa; lower premolars with well marked anterior and posterior cusps; M_1 with metaconid and small talonid; M_2 lost in all except the most primitive species.

Genotype.—*Hyaena chaeretis,* Gaudry (1861, p. 534, Pl. xi, figs. 3-6).

Species.—In addition to the genotype, which occurs in the Pontian of Pikermi and Samos, *L. macrostoma* (Lydekker 1884, p. 298), from the Dhok Pathan stage of India; *L. lunensis,* Del Campana (1914, p. 87), from the Middle Pliocene of Monte Olivola; *L. parva,* Khomenko (1914, p.), from Taraklia and Novo Elisavetovka; *L.* (?) *dubia,* Zdansky (1924, p. 91), from the Pontian of China; *L. proava,* Pilgrim (1910, p. 65); from the Chinji stage of India; *L. chinjiensis,* sp. nov., also from the Chinji stage of India are here included in the genus.

Lycyæna macrostoma (Lydekker).

(Pl. V, figs. 9, 10.)

1884. *Hyaena macrostoma,* Lydekker, *Pal. Ind.,* (10), II, P. 298, Pl. xxxvi, fig. 2; Pl. xxxvii; Pl. xxxviii, fig. 4; Pl. xxxix, fig. 6.
1897. *Lycyaena macrostoma* (Lydekker), Trouessart, Catalogus Mammalium, p. 320.
1929. *Hyaena* (*Lycyaena*) *macrostoma,* Lydekker, Matthew, *Bull. Amer. Mus. Nat. Hist.,* LVI, p. 492.

Diagnosis.—A *Lycyaena* of slightly greater absolute dimensions than *L. chaeretis;* nasal opening relatively larger and extending further back than in *L. chaeretis;* teeth relatively rather stouter; canine slightly larger; I^3 and I_3 more enlarged; P_1 somewhat more persistent; P^3 and P_4 relatively larger; skull more elongate and narrower than in *L. lunensis.*

Holotype.—The skull described and figured by Lydekker (1884, p. 298, Pl. xxxvi, fig. 2; Pl. xxxvii) under the name of *Hyaena macrostoma.* It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 44.

Referred specimens.—The left mandibular ramus from Jabi, Salt Range (G. S. I. no. D 52), described and figured by Lydekker (1884, p. 301, Pl. xxxviii, fig. 4; Pl. xxxix, fig. 6).

The left mandibular ramus (G. S. I. no. D 136) from Hasnot, figured in Pl. v, figs. 9, 9*a*, 9*b* of the present work.

The right mandibular ramus (G. S. I. no. D 138) from Hasnot figured in Pl. v, figs. 10, 10*a* of the present work.

The species is not uncommon in the Dhok Pathan stage of the Middle Siwaliks, and other more imperfect fragments have been collected.

Locality.—The type locality is Jabi, Salt Range. It has also been found at Hasnot.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description.—The holotype has been fully described by Lydekker, and no other specimens of the skull or upper dentition are known. Matthew (1929, p. 492) observes that 'the protocone of this species is reduced or absent, although there is a fairly strong internal root'. I am unaware on what evidence he bases his opinion, since I can see no reason why a well developed protocone should not have stood on the internal root. Such is certainly the case in the allied species *Lycyaena chaeretis* (Pilgrim, 1931, p.109). The ramus (G. S. I. no. D 52) described by Lydekker and referred to this species, showed only the alveoli of M_1 and was broken off behind this point. The ramus (G. S. I. no. D 136) agrees so closely with that figured by Lydekker that there is no doubt that they belong to the same species. This specimen shows the base of the coronoid process and the beginning of the masseteric fossa, but the portion behind this is missing, and only the hinder part of the alveolus of the canine is preserved. The measurements of these specimens as well as those of the holotype are tabulated on pages 128 and 129 of the present work.

The ramus and the teeth are relatively slender. M_1 is much longer than P_4, but is relatively shorter than in *Ictitherium*, *Hyaena* and *Crocuta crocuta.* The talonid is short, only one quarter the length of the trigonid. Its surface is slightly eroded at the extreme end in the Hasnot ramus, but it seems to have had much the same structure as in *Ictitherium*, namely three cusps, of which the hypoconid is long and united to the protoconid; the entoconid, separated by a cleft from the metaconid; and a small approximately median hypoconulid behind the other two. The metaconid is small and lies well behind the protoconid. The surface of the jaw behind M_1 is well preserved and is absolutely without any indication of an alveolus for M_2, from which we may safely conclude that it was absent. P_4 is a slender tooth with a high main cusp, a large posterior accessory cusp and a well marked anterior one, of which the summit has been worn down. There is a strong, somewhat hollowed postero-internal cingulum; also a postero-external cingulum and an antero-internal cingulum. P_3 is shorter than P_4 with a much weaker posterior cusp and cingula and an anterior cingulum without a cusp. P_2 is badly preserved in all three rami. It is double-rooted and had a well marked anterior cingulum. P_1 is known only by its single alveolus, between which and the canine there is a diastema of about 11 mm. The root of I_3 shows that it was a small tooth compared with that of the modern hyaenas.

Remarks and comparisons.—Lydekker's opinion as to the affinity of this species to *Lycyaena chaeretis* from Pikermi was based on the resemblance of the lower premolars of the two species, on the assumption that the ramus D 52 was correctly referred to the holotype skull. At that time the skull of *L. chœretis* was unknown, but recently a fairly well preserved skull of that species has been described and figured (Pilgrim, 1931, pp. 106-109, text figs. 28-30). A comparison of this with the holotype of *L. macrostoma* leaves no doubt that the two species are closely allied, and it could not be wholly unreasonable to regard the Indian form as merely a variety of the European one. The skull of *L. macrostoma* is absolutely larger in all its dimensions than *L. chaeretis*, but only slightly so. All the known rami of the former are also larger than the holotype ramus of the latter and also than the mandible in the British Museum (Br. Mus. no. M 8979) mentioned together with the skull (Pilgrim, 1931, p. 110). The deformed condition of the Pikermi skull does not permit of an exact comparison of the width of the two skulls, and it cannot be predicated that that of *L. macrostoma* is any stouter. The teeth, however, are decidedly so; also P^3 is relatively longer than in *L. chaeretis* while P^2 is relatively shorter; the nasal opening in *L. macrostoma* extends rather further back which makes it relatively larger and causes it to face upwards more than in the Pikermi species; the incisors occupy a relatively greater space mainly on account of the somewhat greater enlargement of I^3.

Del Campana (1914, p. 87) has compared the skull of *Lycyaena lunensis* from Monte Olivola in detail with that of *L. macrostoma.* His observations need not be repeated here. It is obvious that the broader and less elongate skull; the more crowded and overlapping teeth; the broader nasals; the greater distance separating the frontals and the premaxillae; the great reduction of the metacone in P^4; and the smaller size of M^1 clearly distinguish the Italian species, which is in a more advanced stage of development.

The mandibles show just the same resemblances and differences between *L. macrostoma* and *L. chaeretis* as the skulls. There is some variation both in the Pikermi and the Indian species in regard to the relative dimensions of the teeth, but the teeth as a whole are decidedly stouter in the Indian species, P_4 distinctly longer and P_2 distinctly shorter than in *L. chaeretis.* The new mandibles of *L. chaeretis* (Br. Mus. no. M 8979) and of *L. macrostoma* (G. S. I. no. D 136) show that the structure of M_1 in both was identical and that M_2 was absent. The latter character is especially important, since Schlosser (1923, p. 477) and others have assumed, on what grounds I am unware, that M_2 was present in *Lycyaena.* The specimens of both species which have now been described seem definitely to negative this, though M^2 still exists in *L. proava* (p. 131). Lydekker's remark as to the greater post-canine diastema in *L. macrostoma* seems to be without great significance, as this varies in the case of both species.

Measurements of skull and upper dentition of species of Lycyaena.

	Lycyaena chaeretis (Br. Mus. no. M 8978).	*Lycyaena macrostoma* (G. S. I. no. D 44).	*Lycyaena lunensis* from Monte Olivola.	*Lycyaena dubia* Zdansky from Shansi, China.	*Hyaena hyaena* (specimen in Indian Museum, Calcutta).
Length of skull from incisor border to back of occipital condyles.	232	app. 251	..	..	212
Length of skull from incisor border to lower border of foramen magnum.	..	app. 236	..	..	201
Length of skull from incisor border to back of palate	127	136	..	..	113
Height of lambdoidal crest above lower edge of occipital condyles.	..	app. 65	..	..	57
Height of sagittal crest above lower edge of occipital condyles.	..	..	..	..	88
Width of skull between posterior ends of P^4	87	93·5	..	73	82
,, ,, behind canines	..	47	..	..	50
,, ,, opposite canines	..	53	..	..	52
,, ,, between post-orbital processes	..	70·5	..	..	68
Width of brain case opposite zygomatic process of squamosal.	..	56	..	..	68
Width of occipital condyles	44	..	..	..	41
Width of upper incisor series	26·5	29	..	30	31
Interval between canines	..	29	..	..	33
Interval between canine and hinder end of P^4	..	89	..	..	72
Interval between canine and P^2	..	15	..	..	10
Length of premolar series	80	86	..	..	..
P^2 ant. post. diam.	16·7	16	21	..	17
P^2 trans. diam.	9	..	12	..	10·5
P^3 ant. post. diam.	19·8	23·4	25·4	..	21·5
P^3 trans. diam.	12·0	12·5	12·7	..	14
P^4 ant. post. diam.	31·5	33·6	33	..	30
P^4 trans. diam.	17·0	17	..	..	18·5
M^1 ant. post. diam.	7	8	4·5	..	6
M^1 trans. diam.	14	16·8	10	..	14
Canine ant. post. diam.	16	..	16·7	..	16·5

Measurements of mandibles of species of Lycyaena.

	Lycyaena macrostoma (G. S. I. no. D 52).	*Lycyaena macrostoma* (G. S. I. no. D 136).	*Lycyaena chaeretis* (holotype ramus Paris).	*Lycyaena chaeretis* (Br. Mus. no. M 8979).	*Lycyaena parva* (Odessa Museum ramus figured by Alexejew).
Length of cheek teeth series (P_2—M_1)	app. 83	app. 85	..	78	..
P_2 ant. post. diam.	app. 15	app. 15	16	15·4	..
P_2 trans. diam.	..	..	..	7·1	..
P_3 ant. post. diam.	20·0	19·1	20	18·1	..
P_3 trans. diam.	11·1	11·0	..	9·5	..
P_4 ant. post. diam.	24·2	23·7	22	21·8	18·6
P_4 trans. diam.	11·9	11·7	11	10·1	9·7
M_1 ant. post. diam.	app. 24	23·0	..	21·6	23·3
M_1 trans. diam.	..	10·9	..	10·0	9·6
Distance from posterior border of canine to anterior border of M_1.	76·5	app. 70	72	71·5	..
Depth of ramus beneath P_1	35	35	34	..	..
Depth of ramus beneath M_1	app. 42	..	37	41·6	..

LYCYÆNA MACROSTOMA, var. VINAYAKI, var. nov.

(Pl. VII, figs. 6—9 ; Pl. IX, fig. 3.)

Diagnosis.—A *Lycyaena* of larger size than *L. macrostoma* type ; P_3 longer in relation to P_4 than in *L. macrostoma* type ; P_4 broader posteriorly, with a more prominent internal cingular shelf ; P^2 longer in relation to P^3 ; P^3 with a prominent internal lobe.

Syntypes.—Four associated fragments consisting of the right mandibular ramus with P_4 and of the left ramus with P_3 ; also the isolated right P^3 and the left P^2. These are figured respectively in Pl. vii, figs. 8, 8*a* ; 9, 9*a* ; 6, 6*a* ; 7, 7*a*. They are in the collection of the Geological Survey of India in Calcutta and are registered D 139 and D 137 respectively.

Referred specimen.—A fragment of the right maxilla (G. S. I. no. D 260) containing P^3 and the anterior roots of P^4, collected by D. N. Wadia at Chhokar, Salt Range area. This specimen is figured in Pl. ix, figs. 3, 3*a*.

Locality.—The type locality is Hasnot. The referred specimen came from Chhokar.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description and comparisons.—The stage of wear and the weathering of the four syntypes strongly supports the evidence derived from their supposed association in the same spot that they belong to the same individual. Seeing, however, that there is a doubt regarding it, I class them as syntypes and not as a single holotype. Their measurements are Tabulated on pages 110 and 111.

The rami and the lower premolars agree with the holotype and other specimens of *Lycyaena macrostoma* in regard to their slenderness and general structure. P_3 is, however, longer in relation to P_4 than is the case in the type, thus bearing a greater resemblance to *Lycyaena chaeretis.* Moreover P_4 is broader in its posterior part and the internal cingular shelf is broader and has a prominent serrated edge. Beyond its relatively greater size P_3 does not differ from the type. The crown of P^3 is not preserved in the holotype of *L. macrostoma* but its roots agree in respect to their relative dimensions with the corresponding syntype of *L. macrostoma* var. *vinayaki*, although the latter is an absolutely larger tooth. Like the P^3 of *Hyaena hyaena* there is a large posterior and a small anterior cusp but the latter lies to the inside of the line joining the main and the posterior cusps whereas in the recent species the three cusps are in a straight line. The internal lobe is more prominent than in *Hyaena hyaena*, but its root is fused with the main posterior root. The presence of this inner lobe and the length and slenderness of the tooth distinguishes it from Pliocene and post-Pliocene forms of *Crocuta* including *C. mordax.* On the other hand it closely resembles P^3 in the skull of *Lycyaena chaeretis* figured by Pilgrim (1931, p. 109 text fig. 30) so far as its structure goes, though it exceeds it in size. P^2 is very similarly constructed to P^3 but is relatively much longer than P^2 in the holotype skull *of Lycyaena macrostoma.*

The referred right maxilla (G. S. I. no. D 260) figured in Pl. ix, fig. 3, contains only one perfect tooth, P^3. This agrees fairly well both in size and structure with the syntype (D 137). The inner lobe is somewhat less prominent. Behind it are the remnants of two roots abreast, which are obviously those of P^4. This shows clearly that the protocone was widely extended inwardly as is the case with the species *L. macrostoma* type and *L. chaeretis*.

These remains belonged to an animal which exceeded the typical *L. macrostoma* in size, but in view of the variation in the relative size of the teeth, which is found in other species of *Lycyaena*, I do not think that the differences mentioned can be regarded as justifying more than a varietal separation.

LYCYÆNA (?) PROAVA, Pilgrim.

(Pl. V, figs. 1, 6.)

1910. *Palhyaena proava*, Pilgrim, *Rec. Geol. Surv. Ind.*, XL, p. 65.

1913. *Progenetta proava*, Pilgrim, *op. cit.*, XLIII, pp. 282, 312.

Diagnosis.—A *Lycyaena* of extremely small size, probably smaller than *Ictitherium robustum*; depth of ramus exceeding the length of M_1 in the ratio of

5 : 3 ; M_1 relatively slightly longer and with a slightly longer talonid than in *L. macrostoma* ; with relatively large metaconid ; M_2 present but small.

Holotype.—The left mandibular ramus containing M_1 and P_4 mentioned under the name of *Palhyaena proava* (Pilgrim 1910, p. 65) and figured in the present work (Pl. v, figs. 6, 6*a*). It is in the collection of the Geological Survey of India in Calcutta regd. no. D 126.

Referred specimen.—The right maxilla of a juvenile individual (G. S. I. no. D 212) containing three milk molars, P^4 much broken and the perfect M^1 from Chinji. It is figured in Pl. v, figs. 1, 1*a* of the present work.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The holotype seems to be almost a replica in miniature of the ramus of *Lycyaena macrostoma*, except that M_1 is slightly longer relatively and has a proportionately longer talonid. The metaconid is also relatively stronger. The most important difference apart from its size seems to lie in the presence of M_2, if one may infer that by what appears to be a small circular alveolus behind M_1, filled up with a hard red cement. The hypoconid and the entoconid in M_1 are equally strong cusps. The hypoconulid is much lower than the other two and is only slightly behind them in the median line so that the posterior end of the tooth is somewhat truncated. There is a marked external cingulum which continues just round the front of the tooth. P_4 is markedly inferior in length to M_1. The main cusp lacks its summit. There is a strong posterior cusp with a cingulum which forms a broad shelf on its inner side, and a somewhat weaker anterior cusp.

The referred maxilla (G. S. I. no. D 212) belongs to a juvenile individual, in which the milk dentition is still in place, though considerably damaged. The alveolus of the single-rooted mm^1 is visible immediately behind that of the canine. This is succeeded by the almost perfect mm^2. A diastema of about two mm. separates this from mm^3, which has lost the summits of the paracone and the protocone, but is otherwise well preserved. The outline of the crown of mm^4 can be made out by its broken base, but the only perfect portion of it is the antero-external corner (? parastyle). The tip of the permanent canine, not yet erupted, is disclosed by the fracture of the maxilla at that point. P^4 is quite concealed in the bone beneath the remnants of mm^4. M^1, though it had not erupted is well exposed by the abrasion of that part of the palate. It has lost a portion of the parastyle, but otherwise shows the structure perfectly. The hinder border of the palate behind M^1 is fairly well preserved and there is no trace of any other germ, from which it may be concluded that M^2 was absent. The upper end of the maxilla is missing but a large part of the rim of the orbit can be seen and in front of it the vertically elongate infra-orbital foramen. The palatal suture is clearly visible for a distance of about 13 mm. opposite mm^2 and the front part of mm^3 ; in front of and behind these points the sutural portion has been broken away, but the shape of the whole palate can be restored from the portion which is perfect. Opposite the alveolus of mm^1 the breadth of the palate is 10·0 mm. ; opposite the end of mm^3 it is 20·0 mm. and opposite the end of mm^4 it is 23·5 mm.; the length from the not yet erupted tip of the canine to the hinder end of the equally not erupted end of M^1 is 46·2 mm.

Mm^2 is a rather slender, elongate tooth, with a not very high main cusp, a minute anterior accessory cusp and a low posterior accessory cusp. The antero-internal corner of the base is slightly expanded, so that the greatest transverse diameter is in the hinder part. Mm^3 is also a slender elongate tooth, with a rather low, pointed paracone somewhat longer than the metacone, from which it is separated by a notch. The metacone forms a low elongate blade, almost in the same line as the paracone. The parastyle is a prominent cusp, approximately the same height as the metacone. It lies very obliquely to the paracone and is separated from it on the external side by a deep, broad valley. On the internal side a low ridge connects it to the paracone. At one point in this ridge there are possibly indications of an original small cusp of which the summit has been broken off. The protocone has a comparatively small antero-posterior diameter but is situated extremely far to the inside of and almost opposite the centre of the paracone. Mm^4 is a triangular tooth, of which the transverse but little exceeds the antero-posterior diameter. The parastyle is a prominent rounded cusp. Of the permanent dentition, the canine seems to have been a large robust tooth. I can form no idea of the length of P^4 but it must have reached as far as the hinder edge of the present position of M^1. Since the latter tooth is so near the surface of the palate it is unlikely that it would have been shifted much to the rear to arrive at its final position in the jaw. M^1 is a large tooth, a little superior in size to mm^4, and it seems to have been more extended transversely. The paracone and metacone are prominent, somewhat elongate cusps, forming an angle of about 45° with the longitudinal axis. The metacone is somewhat smaller than the paracone. The protocone is a prominent cusp, separated from the two external cusps by a somewhat concave area. There is a prominent parastyle forming a broad, shelf-like projection, of which the outer edge has been broken off. The measurements of this specimen are given in the table on page **110**.

Remarks and comparisons.—Originally I was led by a consideration of the general structure of M_1 in this ramus and by its small size to regard it as a species of *Palhyaena* possibly ancestral to *Lepthyaena sivalensis*, in spite of the shortness of the talon of M_1 the length of P^4 and the depth of the ramus. Subsequently it seemed to me that its affinities were closer to *Progenetta* Depéret (=*Thalassictis* Gervais), in which the talonid of M_1 is shorter than in *Ictitherium* and the depth of the ramus is greater. Even so, however, the genus *Thalassictis* seems to be more closely allied to *Ictitherium* than to the Chinji ramus. On the other hand the characters mentioned in which it differs from *Ictitherium* and *Thalassictis* are just those which distinguish *Lycyaena* from the two genera named. The fact that the Chinji species is much smaller, hardly two-thirds the size of the Dhok Pathan *Lycyaena macrostoma*, can hardly be regarded as a valid reason for separating it generically. This equally with the possession of M_2 are characters which might be expected in an earlier and therefore presumably more primitive species.

The dimensions of the type ramus are given in the table on page **111.** It is very much more stoutly built than in any Viverrid or than any species of *Ictitherium.* The difference is very striking if one compares it with the ramus of *Ictitherium sivalense,* in which the length of M_1 greatly exceeds what it is in the Chinji ramus. In this respect it is quite Hyaenine, the thickness of the ramus being relatively not at all inferior to that dimension in *Hyaena hyaena* or *Lycyaena macrostoma.* The depth of the ramus is also greater than in any species of *Ictitherium* or Viverrid though it agrees with the depth of the ramus in *Lycyæna macrostoma.* M_1 has a fairly strong metaconid which does not differ essentially from that of *Ictitherium.* The paraconid and the metaconid are as in *Ictitherium*; the talonid is, however, much shorter. Whereas in *Ictitherium* its length is from one-third to one quarter of the total length of M_1, in the present species it is not above one-fifth of the length of M_1. In *Lycyaena macrostoma* it is even shorter than this. The arrangement of the three cusps of the talonid is essentially the same as in both the genera named, except that the hypoconid is shorter and the hypoconulid stands nearer to the other two, so that the end of the tooth is truncated.

The referred maxilla (G. S. I. no. D 212) seems by its unreduced milk dentition, its broad palate, the strong parastyle and protocone in mm^3, to be referable to the Hyaenidae. Its similarity to the young maxilla of *Hyaenictis graeca* described and figured by Gaudry (1862, p. 96, Pl. xv, fig. 6) adds considerably to the probability that this is correct. The apparent absence of M^2 and the inward position of M^1 seems definitely to exclude a reference to the genus *Ictitherium* and equally to the Viverridae. Moreover the skull is everywhere broader, but especially in its posterior part, than that of young individuals of *Viverra* and presumably of *Ictitherium.* On the other hand it is narrower than in *Hyaena hyaena,* and the front part of the palate is more elongate though less so than in the Viverridæ. The teeth are more slender than the corresponding ones of the modern species of *Hyaena* and *Crocuta,* and equally of the fossil species of these genera in which the milk dentition is known. The more prominent parastyle and protocone of mm^3 distinguish it from the young maxilla of *Crocuta eximia* described and figured by Gaudry (1862, p. 81, Pl. xii, fig. 4). The structure of mm^4 and M^1 seems to be directly comparable with that of the young maxilla of *Hyaenictis graeca* mentioned above, but in that species, mm^4 is larger than M^1, whereas here the reverse is the case. The orbit is very large, differing from that of *Hyaena* and *Crocuta* as well as of the Viverridae. In this respect it is closer to *Lycyaena macrostoma.* There is in fact nothing which seems to militate against a reference to the genus *Lycyaena,* and since it corresponds in size as nearly as may be with the holotype ramus of *Lycyaena proava,* it seems that the provisional reference is justified. In fact its existence adds support to my opinion that a very small and primitive form of *Lycyaena* existed in the Chinji stage of the Lower Siwaliks.

LYCYÆNA (?) CHINJIENSIS, sp. nov.

(Pl. VI, fig. 6.)

Diagnosis.—A *Lycyaena* of about the same size as *L. proava*; with a more slender M_1; a much weaker metaconid; M_2 absent.

Holotype.—The right mandibular ramus with M^1 just erupting and quite unworn, figured in Pl. vi, figs. 6, 6*a*, 6*b* of the present work. It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 233.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The holotype is only a fragment of the right ramus of an immature individual, lacking everything in front of M_1 which is on the point of erupting, and with only a small part of the ramus behind M_1 preserved. The M_1 seems to be a characteristic Hyænid tooth and to resemble closely in structure that of *Lycyaena macrostoma* and *L. proava.* It is a slender tooth with a small metaconid and a short talonid, showing the three cusps admirably, the hypoconid being the largest but less elongated than in *L. macrostoma.* The entoconid is much smaller. The hypoconulid is well marked midway behind the other two. It cannot be said to be quite certain that M_2 is absent, but there is no trace of its root in the ramus behind M_1. The dimensions of this specimen are included in the table on page 111.

Remarks.—Apart from the absence of M_2, which as remarked above is not quite certain, this species is distinguished from *L. proava* by M_1 being more slenderly built and having a much smaller metaconid. It agrees with *Lycyaena* and differs from *Ictitherium* in precisely the points which have been already noted in the case of *Lycyaena proava.* The length of M_1 slightly exceeds that of the same tooth in the holotype of *L. proava*, but not sufficiently to possess any significance.

Genus : CROCUTA, Kaup.

1828. *Crocuta,* Kaup., Oken's Isis, XXI, heft 11, p. 1145.
1829. *Crocotta,* Kaup., Skizz. Europ. Thierw., p. 78.

Diagnosis.—Hyaenidae of large size, with shortened facial region; posterior opening of alisphenoid canal small or absent; sagittal crest high; occipital high and subtriangular in shape in hinder view; lambdoidal crest not particularly prominent; third upper incisor very considerably larger than the others; first premolar small, sometimes absent; hinder premolars large and very stoutly built, with rather blunt cusps; P^4 progressively lengthening, with protocone either large or much reduced; M^1 placed at right angles to P^4, large in the primitive members, but progressively diminishing in size; M^2 absent; P_1 present or absent M_1 progressively lengthening, with metaconid either absent or vestigial; M_2 absent; posterior limbs shorter than anterior limbs, in particular pes shorter than manus; first digit vestigial; foot bones broad and stoutly built, unciform with a strong plantar process for articulation with the scapholunar; fifth metatarsal articulating extensively with the cuboid, without prominent external peroneal ridge; phalanges showing no trace of the original retractile power of the claws.

CROUCTA SIVALENSIS (Falc. and Caut.).

1835. *Hyaena,* Baker. *Journ. s. Soc. Beng.,* IV, p. 569, Pl. xlvi, figs. 22, 23.
1868. *Hyaena sivalensis,* Falconer and Cautley, Pal. Mem., I., p. 548.

1884. '*Hyaena felina* Bose' Lydekker, *pars*, *Pal. Ind.*, (10), II, p. 281, fig. 13; p. 285, Pls. xxxviii, fig. 1, xxxix, fig. 1.

1884. *Hyaena colvini* Lydekker, *pars*, *Ibid.*, p. 294, Pl. xxxv, fig. 5.

"*Non* '*Hyaena sivalensis* Bose' Lydekker 1884, *Ibid.*, p. 303, Pl. xxxiv.

Diagnosis.—A *Crocuta* of large size; skull rather more elongate and with narrower brain case than in most other contemporary species of *Crocuta* including C. *felina* (Bose); teeth relatively low-crowned; M^1 moderately large; P^4 shorter than the united lengths of P^2 and P^3, with metacone only slightly longer than paracone; parastyle very strong, as long as but lower than the paracone; protocone strong and rather remote from the parastyle; P^3 with well developed posterior accessory cusp, anterior accessory cusp weaker; P^2 relatively rather high-crowned, with fairly well marked anterior and posterior accessory cusps; P^1 small, one-rooted; without a post-canine diastema; mandible robust; M_1 rather longer than P_4, without any trace of a metaconid, talonid short; P_4 with large anterior and posterior accessory cusps; P_3 with strong posterior accessory cusp, anterior accessory cusp weaker, P_2 relatively rather high-crowned, with strong anterior and posterior accessory cusps; P_1 absent.

Holotype.—The conjoined skull and mandible described and figured by Baker (1835, p. 569, Pl. xlvi, figs. 22, 23) under the name of *Hyaena,* and referred to by Falconer (1868, I, p. 548) as *Hyaena sivalensis.* It is preserved in the Science and Art Museum, Dublin, regd. no. 42.

Nomenclature.—Matthew (1929, p. 489) has fully discussed the question of the names which have been current for the last forty-five years for the fossil Indian hyaenas. It seems clear that *Hyaena sivalensis,* Falc. and Caut. is not a *nomen nudum,* as Lydekker (1884, p. 279) thought, but is based on a figured and described specimen, now in Dublin.

Referred specimens.—A left mandibular ramus from Jammu (G. S. I. no. D 102) described and figured by Lydekker (1884, p. 285, Pl. xxxviii, fig. 1; Pl. xxxix, fig. 1) under the name of *Hyaena, felina,* Bose. A part of the right maxilla of an immature individual (G. S. I. no. D 46) from the Kangra district, described and figured by Lydekker (1884, p. 294, Pl. xxxv, fig. 5) under the name of *Hyaena colvini,* Lyd. An unfigured ramus (G. S. I. No. D 263) from Basaulan, Siwalik Hills.

Locality.—The holotype seems to have been found in the hills between the Markanda pass and Pinjor, Siwalik Hills. Specimens referred by me to this species were collected near Jammu and in the Kangra district. The fragmentary mandibular ramus (G. S. I. no. D 263), which agrees in size and structure with the Jammu mandible (G. S. I. no. D 102), came from the Pinjor stage of the Siwalik hills near Basaulan.

Horizon.—Probably Pinjor stage of the Upper Siwaliks.

Remarks and comparisons.—When the holotype has had the mandible disengaged from the skull to which it is attached, it will furnish a magnificent specimen, affording ample material for specific distinctions, but in its present state, owing to the teeth being very indistinctly visible, its characters are uncertain. In these circumstances I have had to base the diagnosis given above largely on the referred specimens. The resemblance between the mandible of the Dublin skull and G. S. I. no. D. 102 was noticed by Lydekker, and although (1884, p. 265) he stated that both of them resembled the ramus of *Hyaena felina*, Bose (Br. Mus. no. 16565), which he believed to belong to the same individual as the holotype of *Hyaena felina*, Bose, yet he distinctly leads one to infer that the latter specimen differs greatly from G. S. I. no. D 102, by his remark (1885, p. 86) that the premolars of a specimen referred to *Hyaena colvini* 'are very different from those of the mandible (G. S. I. no. D 102) of *H. felina*, but come very near to those of Br. Mus. no. 16565'. This is actually the case. Not only is D 102 relatively longer and stouter, but the premolars are larger relatively to M_1, and P_4 has a much stronger anterior cusp. So far as I can see from the cast in the British Museum, these are precisely the characters of the holotype Dublin specimen. G. S. I. no. D 102 exceeds the holotype in size, and might be entitled to varietal distinction, but since I have found a ramus (G. S. I. no. D. 263) identical in size with G. S. I. no. D 102 at Basaulan in the Siwalik Hills in beds belonging to the same stage from which I believe the holotype to have been collected, it is unlikely to be a time mutation.

The Kangra maxilla (G. S. I. no. D 46) agrees perfectly in size with the Jammu ramus (G. S. I. no. D 102). It is too big for the holotype and paratype of *Hyaena colvini* and moreover the paracone and parastyle are much larger relatively to the metacone than in *Hyaena colvini* and the protocone is much wider.

If the holotype should display the characters predicated, then *Crocuta sivalensis* is a very definite species. It is more slender than *C. felina* (Bose), as shown by the face and occiput being longer although the width is no greater; in fact behind the post-orbital processes it is actually narrower than *C. felina.* The gradual curvature of the temporal ridges as against their sudden bend in *C. felina* is not to be insisted upon, as it is probably a mark of the youth of the animal. The accessory cusps are stronger than in *C. felina* and P^1 is present. The structure of P^4 and M_1 is indistinctly seen in the holotype, nor does Matthew's figure (1929, fig. 26) improve matters as he has not distinguished between P_4 and M_1, both these giving the appearance of a single tooth in his drawing. In G. S. I. no. D 46, however, P^4 has a remarkably prominent paracone, parastyle and protocone and a large M^1, which distinguish it from *C. spelaea,* while the ramus G. S. I. no. D 102 has a relatively small M_1, a relatively high-crowned P_2 and a rather long post-canine diastema which equally distinguish it from *C. spelaea.*

C. colvini has a narrower skull, a very long P^4 due apparently to the length of the paracone and metacone, a smaller protocone and reduced P^2 and P^3.

This species seems to be very closely allied to *C. salonicae* (Andrews) (1918, p. 540) and to *C. brevirostris* (Aymard), of which according to Boule (1893, p. 93) *C. robusta* (Weithofer) (1889, p. 346) is a synonym, these species being also characterised by a short P^4 and M_1, a large M^1 and rather well developed accessory cusps on the premolars. From both of these species it differs in the presence of an anterior accessory cusp on P^3. It agrees with *C. salonicae* in the presence of P^1 but differs from it in the longer P^4 and the larger posterior accessory cusp on P^2. On the other hand it agrees with *C. brevirostris* in the relatively longer P^4 and the large posterior accessory cusp on P^2. P^1 seems to be occasionally present in *C. brevirostris* (Boule, 1893, p. 91). It seems not unlikely that *C. salonicae* might be regarded as the ancestral form of *C. sivalensis* and *C. brevirostris* alike.

Hyaena sinensis Owen, judging by Zdansky's excellent descriptions and figures (1925, p. 22, Pl. iii, figs. 1-5; Pl. iv, figs. 1, 2; 1927, p. 22, text-figs. 3, 4) evidently belongs to the same line, characterised by a large M^1, a short P^4 and M_1, a large parastyle and protocone to P^4, and well developed accessory cusps on the premolars. The mandible figured by Zdansky (1925, Pl. iii, figs. 1, 2) under the name of '*Hyaena ultima*', but subsequently (1927, p. 22) transferred to *H. sinensis*, is much smaller than either of the Indian specimens referred to *Crocuta sivalensis*, but the largest specimens of *Hyaena sinensis* equal in size the largest specimens of the Indian species. In fact on the material available the only difference I can see between the Indian and the Chinese species is the loss of P^1 in the latter. This, however, would be expected in a species which is presumably of later date, perhaps Upper Pleistocene as against Upper Pliocene in *C. sivalensis.* For this reason and also because the undeveloped condition of the holotype of *C. sivalensis* leaves some of its characters uncertain, I refrain from putting *C. sinensis* as a synonym. Lydekker (1884, p. 288) and Matthew (1929, p. 489) seem to have held the same view. I cannot, however, agree with the latter author that it is on the same line as *C. crocuta. C. ultima,* in spite of the retention of P^1 is closer to *C. crocuta* not only because of the minute size of M^1 but also because of the larger metacone in P^4, which also distinguish it from *C. sivalensis. C. honanensis* (Zdansky), which is of approximately the same age as *C. salonicae,* may be a parallel form to the branch which I have indicated. It is a much smaller species than any of the others, and its primitive stage of development is shown by its retention of the metaconid in M_1, which apparently is not the case in *C. sivalensis* or *C. brevirostris.* The mandible of *C. salonicae* is unknown. The metacone of P^4 in *C. honanensis* is already longer than either the paracone or the parastyle, so that it may even be on the direct line to *C. crocuta.*

CROCUTA FELINA (Bose).

1868. '*Felis cristata,* Falc. & Caut.' Falconer, Pal. Mem. I, p. 548, description of unpublished plate of Fauna Antiqua Sivalensis, Pl. K, figs. 1, 1*a-c.*

1880. *Hyaena felina,* Bose, *Quart. Journ. Geol. Soc. London,* XXXVI, p. 130, Pl. vi, fig. 6.

Non '*Hyaena felina* Bose' Lydekker 1884, *Pal. Ind.,* (10), II, p. 282, fig. 13, nec. p. 285, Pl. xxxviii, fig. 1; Pl. xxxix, fig. 1.

Diagnosis.—A *Crocuta* of large size; skull very broad, very expanded at the zygomatic processes; M^1 minute, two-rooted; P^4 long in proportion to the other premolars, but less than the united lengths of P^2 and P^3; metacone relatively large; parastyle weaker than in *C. sivalensis*; protocone large, widely distant from the parastyle; P^3 with large posterior and small anterior accessory cusp; P^2 long, rather narrow, with a high crown and without an internal cingulum; P^1 absent; mandible with M_1 longer relatively to the premolars than in *C. sivalensis*, with no trace of a metaconid.

Holotype.—The skull described and figured by Bose (1880, p. 130, Pl. vi, fig. 6). It is preserved in the British Museum registered no. 15902.

Referred specimens.—A right mandibular ramus (Br. Mus. No. 16565), described and figured by Lydekker (1884, p. 285, Pl. xxxix, figs. 2, 2*a*) and believed by him on account of the size, the stage of wear and the character of the weathering to belong with very strong probability to the same individual as the holotype skull.

The right maxilla (Br. Mus. no. 37138) described and figured by Lydekker (1884, p. 283, Pl. xxxv A, figs. 2, 2 a) is very much less certain. It is much larger than the holotype, but the minute M^1, the longer P^2, and the apparent absence of P^1 seem to make it impossible to refer it elsewhere.

Locality.—Collected by W. Ewer in the Siwalik Hills.

Horizon.—Not definitely known but probably from the Pinjor stage of the Upper Siwalik.

Remarks and comparisons.—On account of the fragmentary nature of the holotype and of the referred mandible it is impossible to compare this species completely either with other described species or with the various hyaenoid remains from the Siwaliks, themselves equally or more fragmentary than the holotype. There seems, however, no doubt as to its specific distinctness. Its nearest affinities seem to lie with *Crocuta crocuta*, though it seems in some ways to be even more progressive than the recent species. The skull characters are extremely similar in the two and they agree in regard to the minute size of M^1, the relatively large size of the metacone of P^4 and the smallness of the anterior cusp of P^3. The present species is distinguished from *C. crocuta* by the absence of P^1 and by the much longer, narrower and higher crown of P^2, without the inner cingulum which is so marked in the recent species and still more so in *Crocuta spelaea. C. spelaea* is larger than *C. felina* and its occipital crest lies more to the rear relatively to the occipital condyles. The sutures of the nasals are not visible in the holotype of *C. felina.* In the referred mandible M_1 is relatively large with a short and narrow talonid, but the anterior cusp of P_4 is less strong than Lydekker's description would lead one to suppose.

The differences from *C. colvini* are stated under the latter species (p. 139). My reasons for differing from Lydekker in his opinion that the holotype of *C. felina*, Bose should be united with the Dublin skull, shown by Matthew to be the holotype of *C. sivalensis* are given on page 136. *Crocuta ultima* (Matsumoto) though having an equally small M^1 differs from the present species not only by the presence of P^1 but also by the longer, more slender skull, by the longer P^4 with a less prominent protocone and the shorter and wider P^2. *Crocuta sinensis* (Owen) was considered by Lydekker (1884, p. 288) to be near '*Hyaena felina*' Bose, but according to Zdansky's descriptions and figures (1927, p. 22) it differs by the large M^1, the stronger parastyle in P^4 and the shorter and wider P^2.

No Chinese Pleistocene species, so far as I am aware, is very close to *C. felina*, nor has any species been as yet found in the Dhok Pathan stage which could in any way be regarded as ancestral to it. On the other hand the Pontian Chinese species *C. honanensis* (Zdansky) (1924, p. 103), to judge from Zdansky's description and figures, has certain characters which indicate that it may be on the direct line to both *C. felina* and *C. crocuta*. It seems to be a moderately robust form, and already the metacone in P^4 has begun to lengthen, unlike what is the case in the contemporary *C. salonicae* and the later *C. colvini*. It is true that it retains many primitive features such as the metaconid in M_1, a moderately large M^1, and P^1 and P_1 are present. These, however, might be expected in a species so much earlier than *C. felina*. In fact even the recent *C. crocuta* still has P^1 and *C. spelaea* occasionally has a vestigial metaconid in M_1, while the maxilla figured by Weithofer (1889, Pl. ii, fig. 2) under the name of *Hyaena topariensis*, considered by Boule (1893, p. 94) as a synonym of *C. perrieri*, retains almost as large an M^1 as in *C. honanensis*. These primitive characters, therefore, cannot be said to militate against the phylogeny suggested.

CROCUTA COLVINI (Lydekker).

1884. *Hyaena colvini*, Lydekker, *Pal. Ind.*, (10), II, p. 290, Pl. xxxv, figs. 1, 2, 4; Pl. xxxv A, figs. 1, 1*a*, 3, 3*a*; Pl. xxxviii, fig. 3; Pl. xxxix, fig. 4. Non Pl. xxxv, fig. 5.

1884. *Hyaena felina*, Bose, Lydekker, *Ibid.*, p. 287, Br. Mus. no. 37141, erroneously quoted as 37140.

Diagnosis.—A *Crocuta* of moderately large size; skull rather slender; occiput rather low; M^1 rather large, three-rooted; P^4 relatively large, exceeding the united length of P^2 and P^3; paracone and parastyle long; metacone not excessively long, about the same length as the paracone; protocone low, moderately distant from the parastyle; P^3 with small posterior cusp and small internally situated anterior cusp; diastema between P^2 and canine seven mm.; P^2 with strong posterior cusp and strong hollowed internal lobe at the posterior corner; P^1 absent; mandible rather slender; M_1 considerably longer than P_4 with rather broad talonid and occasionally a vestigial metaconid; premolars with accessory cusps rather weaker than in *C. sivalensis*.

Holotype.—The skull lacking the occipital region described and figured by Lydekker (1884, p. 290, Pl. xxxv, fig. 2). The greater part of this specimen is preserved in the Geological Survey of India collection in Calcutta, regd. no. D. 47. According to Lydekker (1884, p. 294) the left maxilla of the same skull is believed to be in the Science and Art Museum Dublin regd. no. 41.

Paratype.—The skull described and figured by Lydekker (1884, p. 292, Pl. xxxv, fig. 1; Pl. xxxvi, fig. 1). It is fairly perfect except for the basal portion of the occipital and the teeth, of which only the incisors, canine, P^1 and M^1 are sufficiently well preserved to make out their structure. The specimen is in Calcutta, regd. G. S. I. no. D. 45.

Referred specimens.—Two left maxillae described and figured by Lydekker (1884, p. 293, Pl. xxxv A, figs. 1, 1*a*, 2, 2*a*) from the Upper Siwaliks of the Siwalik Hills, which are in the British Museum regd. nos. 37139 and 37140. Possibly also a left maxilla (G. S. I. no. D. 101) described and figured by Lydekker (1884, p. 294, Pl. xxxv, fig. 4). The latter specimen was collected by Theobald in the Punjab, no more precise locality having been recorded, but possibly it came from the Upper Siwaliks of the Hoshiarpur district.

I have seen four mandibular rami, which have a claim to be regarded as belonging to this species :—(1) G. S. I. no. D. 51 (Br. Mus. cast M. 1553). This formed part of Col. Colvin's collection from the Upper Siwaliks of the Siwalik Hills, originally presented to the Asiatic Society of Bengal. It was described and figured by Lydekker (1884, p. 295, Pl. xxxviii, fig. 3 ; Pl. xxxix, fig. 4), and it corresponds with the holotype by the fact of M_1 being proportionately larger than in *C. felina* or *C. sivalensis.* The ramus is more slender than in either of those species. M_1 has an external cingulum, and a rather larger talonid.

(2) Br. Mus. no. 16578, from the Upper Siwaliks of the Siwalik Hills. This was figured and described by Lydekker (1884, p. 296, text-fig. 14) and is very similar to the first ramus mentioned, though belonging to a slightly smaller individual.

(3) Br. Mus. no. 16526 mentioned by Lydekker (1884, p. 296).

(4) Br. Mus. no. 37141 mentioned by Lydekker (1884, p. 287 ; 1885, p. 83) with the number quoted in error as 37140, and referred by him to *Hyaena felina* Bose. I have cleared this specimen somewhat from matrix and cannot separate it from No. 2 above. It has a large talonid and faint indication of a metaconid.

Locality.—Both the holotype and paratype were collected in the Siwalik Hills and were originally presented by Col. Colvin to the Asiatic Society of Bengal.

Horizon.—Upper Siwalik, probably from the Pinjor stage.

Remarks and comparisons.—I agree with Lydekker that this is perfectly distinct specifically from either *C. sivalensis* or *C. felina.* Matthew (1929, p. 491) considers that it is nearly allied to *C. sivalensis,* but except for the fact that the skull of *C. sivalensis* is slightly more elongate than that of *C. felina* and that of *C. colvini* is much more markedly so and that both species, as I believe, have a large M^1 in distinction from the minute one of *C. felina,* I cannot see much that they have in common which is not equally shown by all other species of *Crocuta.* Matthew diagnoses *C. sivalensis* with a small M^1, apparently on the analogy of *C. felina,* since the holotype of *C. sivalensis* does not show it. I only judge, by the maxilla (G. S. I. no. D. 46) which I refer to it, that it was large. *C. colvini* has a decidedly slender skull with a low occiput, which is very different from either of the other two Upper Siwalik species of *Crocuta.* The considerable excess of length of P^4 over the united lengths of P^2 and P^3 distinguishes it markedly from *C. felina* and only less so from *C. sivalensis.* It is not any nearer to *C. crocuta* or *C. spelaea* on this account, because these species have a much longer metacone and the premolars are less reduced than in *C. colvini,* quite apart from the minute M^1 and more robust build of the skull in the two species named. The protocone of P^4 is also smaller and less remote from the parastyle than in either of the other four species which have been brought into comparison.

C. colvini differs from *C. sinensis* in just the same characters that have been noted above for *C. sivalensis,* except for the absence of P^1 which is shared equally by *C. colvini* and *C. sinensis.*

A closer affinity seems to exist between the present species and *C. ultima* (Matsumoto), as has been noticed by Matsumoto (1915, p. 3). Zdansky (1927, p. 22), however, thinks otherwise. The two species agree in having a slender skull and mandible and a low occiput, an exceptionally long P^4 and M_1 relative to the length of the teeth which precede them; the protocone of P^4 less extended internally than in *C. crocuta*; a similarly shaped P^2 and occasionally a vestigial metaconid in M_1. *C. ultima* is, however, more advanced than *C. colvini* in the longer metacone in P^4 and the smaller M^1, characters which might be expected for a species of later date, as the Chinese species undoubtedly is. On the other hand *C. ultima* is more primitive than *C. colvini,* in so far as it retains P^1 and perhaps the metaconid in M_1 is more persistent than in *C. colvini,* so that I do not think Matsumoto can be right in regarding it as a direct descendant of the Indian species. I cannot trace any Pontian form which might be ancestral to these species. *C. honanensis* is a stouter species and P^4 and M_1 are shorter, while in P^4 the metacone is already longer than the paracone.

CROCUTA CARNIFEX, Pilgrim.

(Pl. VII, figs. 1-5, 12; Pl. VIII, fig. 2.)

1910. *Dissopsalis carnifex, pars* (in error) Pilgrim, *Rec. Geol. Surv. Ind.,* XL, p. 64.
1913. *Hyaena carnifex,* Pilgrim, *Ibid.,* XLIII, p. 312.

Diagnosis.—A *Crocuta* of moderate size; P^4 only three quarters of the united lengths of P^2 and P^3; with metacone very decidedly longer than paracone; parastyle much shorter than paracone; protocone extremely small and low, adjacent to the base of the parastyle; P^3 rather narrow relative to its length, with strong posterior cusp and well-marked anterior cusp situated much on the inner side of the tooth, lateral surface of tooth between the anterior and posterior cusps short and almost flat; with a very definite cingular lobe on the inner side; P^2 similar to P^3 but smaller and with less prominent anterior and posterior cusps, high-crowned; P^1 apparently absent; canine strong, divided into two parts by prominent anterior and posterior keels, the inner part only slightly convex, the outer part strongly so; mandible rather robust in front, slender behind; M_1 only slightly longer than P_4, without any trace of a metaconid, talonid short with a single rather high cusp; P_4 with strong anterior and posterior cusps; P_3 similar to P_4 but with weaker anterior and posterior cusps; P_2 similar to P_3 but much shorter; P_1 absent; post-canine diastema about six mm.; canine rather large, strongly convex on outer side slightly convex on inner side

Milk dentition: Mm_4 only slightly longer than mm_3; mm_3 with exceedingly strong anterior cusp and weaker posterior cusp; mm_2 apparently similar to mm_3 and only very slightly shorter.

Holotype.--The right mandibular ramus of a young individual with the milk dentition still in place and the permanent teeth exposed by chipping away the side of the jaw (G. S. I. no. D. 172), figured in Pl. vii, fig. 1.

Referred specimens.—It is believed that the front portions of the right and left maxillæ in an identical stage of development to the holotype were obtained from the same spot at the top of the Chinji stage south of the village of Nagri and belonged to the same individual. One of these (G. S. I. no. D. 173) is figured in Pl. viii, fig. 2. There must have been the remains of at least two young individuals of the same species entombed side by side, since a portion of a left ramus of a slightly older animal with P_3 and P_4 in embryo were certainly associated with the maxillæ. It is possible that a right P^4 in embryo (G. S. I. no. D. 168) originally formed a part of one of the maxillæ, but as the exact spot in the Chinji zone from which it came is unknown, the association is in doubt. A young left ramus containing P_3 and P_4 quite unworn, (G. S. I. no. D. 171) figured in Pl. vii, fig. 4 in an identical stage of development to the similar fragment mentioned above, also was collected by Vinayak Rao from the Chinji zone from an unknown spot; this may equally have been associated with the other remains to which I have referred. In addition to these the front portions of two left rami (G. S. I. nos. D. 169 and D. 170) figured in Pl. vii, figs. 3 and 12 belonging to adult individuals differing slightly in size were collected by Vinayak Rao from the Chinjis; these may be assigned with little doubt to the same species.

It seems also necessary to refer to this species a fragment of an immature ramus with M_1 quite unworn, (G. S. I. no. D. 164) figured in Pl. vii, fig. 5, which is recorded as coming from Hasnot. This locality, which is different from that of the other specimens, gives it an interest, which it would not otherwise possess, and the occurrence is discussed further below.

Locality.—The type locality is east of Chinji and south of Nagri village. The other specimens were collected either from the same spot as the holotype or from other sites in the Chinji zone, with the exception of no. D. 164 referred to above, which came from Hasnot.

Horizon.—The type locality lies at the very top of the Chinji stage, to which the other specimens also belong, except apparently no. D. 164. Since the bulk of the Hasnot fossils belong to the Dhok Pathan stage of the Middle Siwaliks, the only reason we could have for not classing this specimen as Dhok Pathan, is that it is unique at that horizon, which occasions a doubt as to whether a villager may not have collected this particular specimen in another horizon more remote from Hasnot than was usually the case.

Description and comparisons.—Upper permanent dentition: M^1 is unknown. Apart from the possibility that the germ P^4 (no. D. 168) belongs to the same individual as the holotype or one of the specimens associated with it, we may safely assume that it is conspecific with them, since it not only agrees in size, but also possesses the structure which would be expected in the P^4 of a species so closely allied to the Chinese and Indian varieties of *C. gigantea.* Its small size, only three quarters of the united lengths of P^2 and P^3, is unique, and distinguishes it from P^4 of *Crocuta eximia*, and also, though to a much less extent, from that of *C. gigantea* and *C. gigantea* var. *latro.* Like each of these forms, the protocone is feebly developed, low, and adjacent to the base of the parastyle; it stands however, on a distinct root. It lies farther forward than in *C. eximia.* The metacone is distinctly longer than the paracone and considerably lower. The parastyle is only about half the size of the paracone, and the same height as the metacone.

P^3 is more elongate than in other species of *Crocuta*, more as in *Hyaena.* It has a main cusp of moderate height, a strong posterior cusp and a much smaller anterior cusp. The three cusps do not lie in one straight line, the anterior one being situated very much to the inside of the other two. The inner wall of the tooth between the anterior and posterior cusps is almost flat, while the outer wall is on the contrary strongly convex. On the inner side and approximately midway between the anterior and posterior cusps but much farther away from the summit of the crown is a cingular shelf, which is mounted on a distinct lobe of the hinder root, if indeed it does not actually form a separate root. The elements of this tooth can be recognized in P^3 of every hyaena, but they are represented to different degrees. *Crocuta crocuta* has diverged widely from this type, inasmuch as both the subsidiary cusps are feebly indicated, the inner wall is less flat and the internal lobe of the hinder root is but slightly marked. On the other hand in *Hyaena hyaena*, both the subsidiary cusps are well marked the anterior one more so and the posterior one less so than in the present tooth, while the internal lobe is better marked than in *Crocuta crocuta* but less so than in the present case. On the other hand in *Hyaena hyaena* the three cusps are in one and the same line, but this is more oblique to the antero-posterior axis than in either of the other two, while the internal wall is more convex even than in *Crocuta crocuta.* The sum of these characters gives P^3 of *C. carnifex* a closer resemblance to *Hyaena hyaena* than to *Crocuta crocuta,* but in my opinion this only indicates that *Crocuta carnifex* is nearer the primitive Hyænid root form, from which both *Hyaena* and *Crocuta* have diverged. Its dentition as a whole points to a closer phylogenetic connection with *Crocuta crocuta* than with *Hyaena hyaena.* This P^3 is not very unlike that of *C. eximia,* but the inner wall is flatter, and the tooth is more elongate. The resemblance seems even closer to a P^3 from China figured by Schlosser (1903, Pl. ii, figs. 1, 3) under the name of *Hyaena gigantea,* except for the greatly inferior size, slenderer outline and more pronounced inner lobe of the Indian species. G. S. I. no. D. 208, figured in Pl. vii, fig. 13 of the present work as *Crocuta gigantea,* var. *latro,* comes closer to *C. carnifex* in size but differs from it in precisely the same characters as the Chinese tooth.

P^2 is constructed somewhat after the same fashion as P^3, except that the hinder cusp is much weaker, and the anterior cusp is very feeble and lies entirely on the inner side of the tooth, while the inner lobe of the hinder root appears to be wanting; the tooth is in fact much more like P^3 of *Crocuta crocuta*; in

Hyaena hyaena P^2 is almost identical with P^3 in that species; again there is some resemblance between this species and *C. eximia.* P^1 is absent, or at any rate it has not been yet calcified in the maxilla (D. 173), so that if it were rudimentary it calcifies late and is probably caducous at an early stage.

The canine is a stout tooth with anterior and posterior keels, flattened internally and strongly convex externally. It seems to agree very closely with that of *C. eximia,* except for its inferior size, both absolutely and relative to the premolars.

Upper milk dentition.—Mm^2, the only upper milk tooth preserved is a slender tooth 12 mm. long, with a small posterior accessory cusp and a cingulum, but without any definite anterior cusp. It is figured in Pl. viii, figs. 2b, 2c.

Lower permanent dentition.—Presumably M_2 is absent, but in none of the specimens yet found is the jaw behind M_1 sufficiently well preserved to make this quite certain. M_1, of the holotype is complete except for the summit of the cusp of the talonid. In D. 164, M_1 is almost identical with the corresponding tooth of the holotype, except that the talonid is slightly broader and the antero-external cingulum is rather stronger. In both cases the structure is very similar to that of *Crocuta eximia.* It is a stoutly built tooth without any trace of a metaconid. The talonid is somewhat shorter than in *C. eximia,* and has a single median cusp. Gaudry (1863, p. 83) observes that in *C. eximia* it generally has two cusps. In a specimen at Munich, of which a cast exists in the British Museum, the talonid is unicuspid, and I think I have seen other instances of this. Very exceptionally, according to Gaudry, there are three cusps. The most marked difference between the M_1 of this species and that of *C. eximia* consists in the inferior length of the former relative both to the size of the ramus and to the length of P_4. In fact it is very little longer than P_4. The only species which it resembles in this respect is *C. gigantea* (Schlosser) from China and the Indian species described below under the name of *C. gigantea,* var. *latro.* In both cases M_1 is relatively even shorter than in *C. carnifex.* Schlosser's descriptions and figures indicate that the talonid in the Chinese species was equally short and identical in structure with that of the Chinji tooth.

P_4 is square behind and somewhat tapering in front. It has strong anterior and posterior accessory cusps, of which the latter stands on an expanded inner shelf and has in addition a hinder cingulum. In *C. eximia* the anterior cusp is much weaker while the antero-external corner is swollen at the base giving the anterior end a square outline which differs from the tapering one of *C. carnifex.* P_3 is similar to P_4, but shorter and both the accessory cusps are smaller. It is smaller than the corresponding tooth in *C. eximia,* in which the anterior cusp is practically absent. P_2 resembles P_3 except for its inferior size. In the holotype and in D. 170 it is considerably shorter than P_1 of *C. eximia,* but in D. 169 the difference does not seem to exist judging by the base of P_2, which alone is preserved. P_1 is absent in each of the specimens of the ramus whereas it is present in *C. eximia.* The distance between P_2 and the canine is only half of what it is in *C. eximia.* The canine is quite as large as in *C. eximia* and the ramus seems to be equally stout.

Lower milk dentition.—Of the milk teeth shown in the holotype, figured in Plate vii, fig. 1, the only one which is perfect is mm_3. This lies very obliquely to the antero-posterior axis of the jaw, so that mm_3 is depicted as seen partly from behind. This view causes the anterior accessory cusp to be partially hidden behind the main cusp, so that its size and its isolation from the main cusp are not at all apparent. Actually it is of considerable size, but little less than half the length of the main cusp. It is stouter than the corresponding cusp in mm_3 of *Hyaena hyaena*, but otherwise resembles it. In *Crocuta crocuta* and *C. perrieri* the length of this cusp is decidedly less. In *C. variabilis* it is still stronger. On the other hand the posterior cusp and the encircling cingulum are less developed than in *Hyaena hyaena*, which in this respect differs little from *Crocuta crocuta* and *C. perrieri.* The hinder part of mm_3 of *C. carnifex* agrees very nearly with that of *C. eximia.* The front portion of the tooth seems to differ greatly from Gaudry's figure (1863, Pl. xii, fig. 6) but it is probable that the apparent smallness of the anterior cusp is due to the perspective, since I have seen in the British Museum a young ramus (no. M. 4165) which, if correctly referred to *C. eximia,* shows that the anterior cusp of mm_3 in that species did not differ very appreciably from that of *C. carnifex.* Except by its inferior size this tooth is hardly at all different from mm_3 of *Crocuta gigantea,* var. *latro,* figured in Pl. viii, fig. 3 of the present work. From the roots of mm_4 it may be inferred that that tooth was only slightly longer than mm_3 thus differing from *C. eximia,* still more from *C. crocuta,* but most of all from *Hyaena hyaena.* In *C. perrieri* mm_4 and mm_3 seem to have the same relative dimensions as in the present species. Mm_2 is shorter than mm_3, in which it differs from *C. gigantea,* var. *latro,* and agrees with other hyaenas. The fracture of the crown does not, however, permit of a comparison between its structure and that of other species. No tooth anterior to mm_2 has been preserved in the holotype as found.

Remarks.—The structure of P^4 in this species is a clear indication of its affinity with the species *Crocuta eximia, C. variabilis, C. gigantea* and *C. gigantea,* var. *latro.* Since the first of these is clearly a primitive though somewhat divergent branch of *Crocuta,* it is necessary to place all these forms in that genus. We can hardly doubt that the shortness of both P^4 and M_1 point to *C. carnifex* being in a more primitive stage of development than *C. eximia.* On the other hand *C. eximia* is less progressive inasmuch as it still retains P^1 and P_1, though it should be remarked that P^1 is occasionally absent (Lydekker, 1884, p. 277). Furthermore the front premolar is generally present in Pleistocene and recent species of *Crocuta.* In any case it is obvious that the Pikermi species cannot be a direct descendant of the Chinji one, and one would infer that they were both migrants from the original centre of distribution. It is far more likely that *C. gigantea,* var. *latro,* which appeared in the Nagri stage, and *C. gigantea,* type of the Pontian of China, represent successive stages of descent from *C. carnifex.* P^4 in both the former species is longer than in *C. carnifex,* and though M_1 is shorter relative to P_4 than in *C. carnifex,* this is entirely due to the strong anterior cusp and great length of P_4 in the Chinese and Indian varieties of *C. gigantea.* This is quite in accord with the opinion which I have expressed

(Pilgrim, 1913, pp. 307-314; 1925, p. 202; 1926, p. 91), that the Nagri stage corresponds to the Sarmatian and the bulk of the Chinji stage to the Tortonian. It seems then that *C. carnifex* is the earliest species of *Crocuta* known. Unfortunately the absence of hyaenids from the Lower Chinji and Kamlial stages and of a pre-Pontian fauna in China deprives us of help towards verifying my theory as to successive Hyaenid migrations into Europe, India and China or of locating the centre of distribution, whence the assumed successive waves of migration arose.

CROCUTA GIGANTEA (Schlosser) var. LATRO, nov.

(Pl. VII, figs. 11, 13; Pl. VIII, figs. 1, 3.)

1903. *Hyaena gigantea*, Schlosser, *Abhandl. bayer. Akad. Wiss. München*, XXII, p. 35, Pl. ii, figs. 1-3, 6-8.

1913. *Hyaena* cf. *gigantea*, Schlosser, Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, pp. 282, 289.

Diagnosis.—A *Crocuta* of large size; P^4 longer than in *C. carnifex* but still slightly shorter than the united lengths of P^2 and P^3; parastyle shorter than paracone; protocone extremely small and low, adjacent to the base of the parastyle; P^3 rather broad relative to its length; posterior and anterior cusps well marked but weaker than in *C. carnifex*; inner surface between the accessory cusps rather flat, but less contracted than in *C. carnifex*; outer surface between the accessory cusps extremely convex; mandible robust in front, slender behind with deep masseteric fossa; M_1 approximately the same length as P_4; P_4 with very strong anterior and posterior cusps; P_2 with strong posterior cusp and feeble anterior cusp; *Milk dentition*: Mm_3 with exceedingly strong anterior cusp and weaker posterior cusp; mm_2 longer than mm_3 and similar in structure.

Holotype.—The right maxilla containing the front portion of P^4 hardly at all worn and showing the outline of the entire base of the crown both in P^4 and P^3 (G. S. I. no. D 206), figured in Pl. vi, fig. 2, from the Dhok Pathan stage of Hasnot.

Referred specimens.—A left P^3 very slightly worn (G. S. I. no. D 208), which agrees exactly in size and outline with the broken crown of P^3 in the holotype and may belong to the same individual from the Dhok Pathan stage of Hasnot. This is figured in Pl. vii, fig. 13.

The hinder portion of the right mandibular ramus with the angle and condyle complete, lacking the tip of the coronoid process, containing P_4 and the alveoli of M_1 from the Nagri stage about two miles N. 35° E. of Kadirpur, Salt Range (G. S. I. no. D. 209). This is figured in Pl. viii, figs. 1, 1*a*. From the ratios of the corresponding upper and lower teeth of *Hyaena gigantea* type it appears that this specimen belonged to an individual of approximately the same size as the holotype.

A fragment of the left mandibular ramus containing P_4 and the roots of M_1 but lacking everything behind this point, though the ramus is complete below P_4, from the Dhok Pathan stage of Nila (G. S. I. no. D 162). It agrees with D. 209 in structure and relative sizes of P_4 and M_1, but belonged to a much larger individual than the holotype. This is figured in Pl. vii, figs. 11, 11*a*.

A fragment of the right mandibular ramus of an extremely juvenile individual (G. S. I. no. D 231) which when fully grown would probably have equalled in size the owner of the ramus D. 162. This came from the Nagri stage of Haritalyangar in the Simla Hills. Mm_2 and mm_3 are in place, and a germ tooth, probably P_2, has been developed out of the jaw. No germ can be discovered in the front portion of the jaw, so that P_1 is probably absent. This is figured in Pl. viii, figs. 3, 3*a*, 3*b*. The measurements of all the specimens are collected on pages **110, 111**.

Locality.—The type locality is Hasnot. Referred specimens have been found at Nila, Kadirpur and Haritalyangar.

Horizon.—If all the above specimens are correctly referred to this variety of *C. gigantea*, the form first appeared in the Nagri stage, and persisted into the Dhok Pathan stage.

Description and comparisons.—The holotype and the various referred specimens resemble so closely the corresponding parts of *Hyaena gigantea* described and figured by Schlosser from China that, except for their considerably inferior size and that the protocone of P^4 lies more forward in the case of the Indian form, I am unable to recognize any distinguishing features which seem to be in any way significant. I am, therefore, forced to regard the Indian form as a smaller local variation of *Crocuta gigantea.* Even in India the species is susceptible apparently of some variation in size, which evidently bears no relation to the time level, since larger and smaller forms occur at the same horizon, so that so far as India is concerned, the variation in size is probably individual. Next after *C. gigantea*, *C. carnifex* is the closest ally to this species. The conformation of P^4 is similar. The protocone shows an equal degree of degeneration. The metacone is probably longer relative to the paracone than in *C. carnifex.* Even if P^2 of this species, which is unknown, were as long as P^3, the length of P^4 relative to the united lengths of P^2 and P^3 would be greater than in *C. carnifex*, indicating an advance in the direction followed by the genus as a whole in the course of its evolution. P^3 is a stouter tooth than in *C. carnifex;* the accessory cusps occupy less room on the inner side of the tooth so that the flat area between them is greater than in *C. carnifex;* the inner lobe is less prominent. The back of the palate is too poorly preserved to allow of any observation of M^1, but Schlosser's (1903, p. 36) supposition that it was a small tooth seems to me unlikely in such an early species. The degeneration of M^1 is characteristic of a late stage of Hyaenid development.

Mandible and lower permanent dentition.—The specimen which shows most of the mandible is G. S. I. no. D 209 from the Nagri stage about two miles N. 35° E. of Kadirpur in the Salt Range area. This is almost complete as regards the hinder portion of the right ramus, lacking only the top of the ascending ramus and the hinder end of the angle. Unfortunately P_4 is the only tooth preserved, though the roots of M_1 enable the length of that tooth to be very closely estimated. P_4 is in a somewhat advanced stage of wear. It agrees precisely in structure with the P_4 of *Hyaena gigantea* described and figured by Schlosser (1903, p. 32, Pl. vi, fig. 7) and its length bears the same proportion to that of M_1 as in the Chinese species, though it is very considerably smaller. So far as it can be compared with the holotype, it seems to have belonged to an individual which was as nearly as possible of the same size, since the length of P^4 in the holotype and P_4 in no. D 209 bear the same proportion to one another as in the corresponding teeth assigned by Schlosser to *C. gigantea*. The hinder part of the ramus is characterised by extreme slenderness, even more marked than in the species *C. colvini* or than in the genus *Hyaena*. If the juvenile jaw (G. S. I. no. D 231) is correctly assigned to the same species, the jaw stoutened considerably in its front portion, which is comparable to most other species of *Crocuta* in this respect. The ascending ramus slopes backward at a very low angle with the horizontal, and must have ended at a considerable distance behind the condyle, so that its hinder border between its summit and the condyle forms a very sharp loop similar to that of *Hyaenictis*. The masseteric fossa is extremely deep, both upper and lower margins being elevated into high ridges, of which the upper one at any rate actually overhangs the fossa. The end of the angle seems to have been markedly bent downward. The crown of P_4 is, as has been said, practically identical in structure with that of *C. gigantea* from China with a very strong anterior cusp, a somewhat weaker posterior cusp, with a cingulum which surrounds the posterior end and forms a broad shelf on the inner side of the posterior cusp. P_4 in *C. carnifex* is absolutely smaller and relatively to the length of M_1 is somewhat shorter; its anterior cusp is considerably weaker, but the hinder end of the tooth agrees closely with that of P_4 in D 209.

The left ramus (G. S. I. no. D 162) from Nila agrees closely in structure with the ramus just described, but considerably exceeds it in size. Only P_4 and the roots of M_1 are present and only the beginning of the masseteric fossa is shown. This portion of the ramus is quite as slender relatively as in D 209. P_4 is somewhat less worn than in D. 209, but even so the anterior cusp is slightly weaker in the Nila specimen. In the hinder part of the tooth the inner shelf is somewhat flatter and has a minute cuspule. M_1 does not seem to be any longer than P_4.

A fragmentary right ramus of an extremely young individual (G. S. I. no. D 231) from the Nagri stage of Haritalyangar in the Simla Hills, contains mm_2 and mm_3, and the alveolus of the milk canine. Still embedded in the jaw are the germs of the permanent canine and of a premolar, which seems from its size and position in the jaw, and also by the apparent absence of any germ tooth in the bone in front of it, to be P_2. The structure of the milk teeth and particularly that of mm_3 and of P_2 are sufficiently like that of the corresponding teeth of *C. carnifex*, to show that it was an allied species. On the other hand the size of the ramus when adult would have been the same, as nearly as one can say, as that of the Nila ramus D 162. There is, therefore, a strong probability that it belongs to the species *C. gigantea*, var. *latro*. Since even in its juvenile condition the front part of the ramus was as stout as the hinder part of the adult Nila ramus, it is evident that when adult the symphyseal portion of the ramus must have been extremely stoutly built, probably even more so than in *C. carnifex.* From what can be seen of the germ of the canine it was of large size, two keels were present and both the inner and outer sides were convex. P_2, figured in Pl. viii, fig. 3*b*, has been considerably damaged in extraction from the jaw, but it shows a strong main cusp with anterior and posterior keels, a strong posterior cusp with a small internal cingular shelf, and probably a much weaker anterior cusp, but the presence of this is not quite certain.

Lower milk dentition.—Mm_4 is not preserved. The hollow in front of mm_2 may or may not correspond to the alveolus of mm_1, but in any case the tooth itself is entirely gone. Mm_3 has lost the summit of the main cusp ; there is an extremely strong anterior accessory cusp which has faint anterior and posterior keels, and is quite isolated from the main cusp ; the posterior accessory cusp is much weaker and less isolated from the main cusp ; a posterior cingulum is present. The postero-internal angle of the tooth is expanded, corresponding to a slight lobe in the root. Mm_2 is slightly longer than mm_3. The anterior cusp is much inferior in height to that of mm_3, but it stands on an expanded shelf which occupies as much room as the entire anterior cusp of mm_3. The posterior cusp is also lower than in mm_3 and no cingulum is evident. These two milk teeth are very similar to those of *C. carnifex.* In that species, however, mm_2 is slightly shorter than mm_3 and the anterior cusp of mm_3 is rather less trenchant. The crown of mm_2 is not preserved in *C. carnifex* so that no comparisons are possible. Mm_3 differs but little from the corresponding tooth of *C. eximia.* The internal lobular expansion at the hinder corner is not seen in mm_3 of *C. eximia.* In regard to the structure of mm_2 *C. gigantea,* var. *latro* differs considerably from *C. eximia,* since in that species both the anterior and posterior cusp and cingula seem to be entirely missing. This greater complication of the Indian mm_2 is correlated with its remarkable length and separates it from every other species of *Crocuta* and *Hyaena* in which mm_2 is known.

Remarks.—The remains described above serve to distinguish this species from every other known *Crocuta* except *C. gigantea* (Schlosser).

Since little except size distinguishes this from the Chinese form, I merely separate it as a local variety. It is of course conceivable that there was a larger and a smaller race even in India, both of which originated in the Nagri stage and continued into the Dhok Pathan stage, but it seems inexpedient on the present meagre material to give these distinct names, especially as they may be due merely to individual variation. The species seems to be a time mutation of *C. carnifex,* the Chinese variety of *C. gigantea* representing the most advanced stage, while the Indian variety is intermediate. The three forms *C. carnifex, C. gigantea,* var. *latro* and *C. gigantea* type, whether they each of them represents a distinct migration or not, are obviously more nearly related to one another than either of them is to *C. eximia* or *C. variabilis.* We thus appear to have evidence of the existence of two small lines within the group with a degenerate protocone in P^4, which diverged continuously at any rate from the Sarimatian.

CROCUTA MORDAX, sp. nov.

(Pl. VI, figs. 1, 3, 4: Pl. VII, fig. 10.)

1913. *Hyaena* cf. *eximia*, Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, pp. 282, 289.

Diagnosis.—A *Crocuta* of large size; M^1 large, with three cusps; P^4 approximately equal in length to the united lengths of P^2 and P^3, metacone equal in length to the paracone but lower, parastyle equal in height to the metacone, of medium length but shorter than the paracone; protocone low, adjacent to the base of the parastyle; P^3 with not very prominent posterior cusp, anterior cusp probably still feebler, inner side between the accessory cusps convex but much less so than the outer side; anterior teeth unknown; mandible rather stout but shallow; M_1 much longer than P_4 with minute metaconid, talonid of moderate length with three cusps; P_4 rather long, posterior accessory cusp rather strong, hinder cingulum, anterior cusp as strong as posterior cusp, the three cusps in a line; P_3 much shorter than P_4 with weaker posterior cusp and still weaker anterior cusp; P_2 much shorter than P_3 with small posterior cusp, anterior cusp hardly indicated; P_1 absent. *Milk dentition*: Mm_4 longer than mm_3; mm_3 longer than mm_2; mm_3 with rather high posterior cusp hanging on to the main cusp, well marked posterior cingulum.

Holotype.—An associated mandible and left maxilla of a young animal with the milk dentition still in place (G. S. I. nos. D 204 and 205) figured in Pl. vi, figs. 1, 3, 4 from the Dhok Pathan stage of Dhok Pathan. The permanent dentition has been exposed on the left side.

Referred specimen.—A fragment of a right ramus, containing the perfect, very slightly worn P_4 (G. S. I. no. D 163), from the Dhok Pathan stage of Hasnot has previously been mentioned (Pilgrim, 1913, pp. 282, 289) under the designation of *Hyaena* cf. *eximia.* It is figured in Pl. vii, fig. 10 of the present work.

Locality.—The type locality is Dhok Pathan. One referred specimen comes from Hasnot.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Description and comparisons.—Upper dentition.—None of the permanent teeth in the left maxilla of the holotype had as yet erupted. They are drawn in Pl. vi, fig. 1 in the position which they actually occupy in the specimen as found after the destruction of the fragmentary milk dentition, but it is probable that the position of M^1 in the palate relative to the germ of P^4 is not its permanent one. M^1 is a large tooth, greatly extended transversely, but with three clearly marked cusps, of which the paracone is much larger than the more ridge-like metacone; there is a broad parastylar shelf, diminishing in breadth towards the rear. The antero-posterior diameter is relatively greater than in *Hyaena hyaena*, and also than in *Crocuta eximia* and *variabilis*, and approaches the shape which we find in the genus *Lycyaena.* P^4 is slightly smaller absolutely than P^4 in the holotype of *C. eximia* figured by Gaudry (1863, Pl. xiv, fig. 1), but agrees with it very nearly both as regards its length relative to that of P^3 and in structure. The metacone is approximately equal in length to the paracone, but lower, while the parastyle is shorter than both of them but equal in height to the metacone.

The protocone is degenerate and resembles closely that cusp in *C. eximia.* This definitely places *C. mordax* in the group which includes *C. eximia, C. variabilis, C. carnifex* and *C. gigantea.* P^3 has not been extracted very cleanly from the maxilla, and in the figure the posterior cusp is entirely hidden behind P^4, while the antero-internal corner has been injured, so that the small anterior cusp is not indicated; nor are the base of the tooth and the root sufficiently well preserved to show the internal lobe. At the same time it could not have differed much either in relative size or structure from P^3 of *C. eximia.* No tooth in front of P^3 has been preserved. It is clear that P^4 relatively much exceeds in length that tooth in *C. carnifex* and *C. gigantea* and the parastyle is longer, while the shape of P^3 is quite different, on account of the weaker accessory cusps and the convex inner side. P^3 of *C. carnifex* is more elongate and that of *C. gigantea* stouter than that of the present species.

Mandible and lower dentition.—The ramus was stoutly built throughout, in which respect it differs from that of *C. carnifex* and *C. gigantea,* which is only stout in its front portion. It is similar to the ramus of *C. eximia* in this, but is considerably more shallow. Not only is this the case in the juvenile holotype but also in the referred ramus (D 163) in spite of its P_4 being more like that of *C. eximia* than the corresponding tooth in the holotype. The absence of M_2 is only presumptive since the jaw has been fractured immediately behind M_1. M_1 is the same length as the specimen of that tooth in *C. eximia* figured by Gaudry (1863, Pl. xiii, fig. 2) and is considerably longer than P_4, thus differing markedly from M_1 of *C. carnifex* and *C. gigantea* in both of which it is either equal to or only slightly longer than P_4. Although it is as stoutly built as in *C. eximia,* it differs from every Pikermi specimen of that tooth in the possession of a small metaconid; this lies rather behind the protoconid and is weaker than the corresponding cusp in *Lycyaena macrostoma* or *Hyaena hyaena* and still weaker than in *Ictitherium hipparionum.* De Mecquenem (1925, p. 51) has, however, recorded that several specimens of M_1 of *C. eximia* from Maragha and one from Salonica possess a rudiment of the metaconid. Zdansky has not mentioned that M_1 in *C. variabilis* ever shows a trace of this cusp. We know that it is occasionally found even in Pleistocene varieties of *C. crocuta.* Much additional material of *C. mordax* is needed before we can be sure that in the Indian species the feature is not also susceptible of variation. The talonid agrees well with that of *Lycyaena macrostoma* though rather broader. Though shorter than in *Ictitherium* it has the same structure and consists of three cusps, the external one being the largest and connected by a ridge to the protoconid, an internal one separated by a valley from the metaconid and a median one behind the other two which is continued into a small cingulum on its external side. The talonid of *Crocuta eximia* seems sometimes not to differ appreciably from that of the present species, although as Gaudry states it is generally bicuspid and even unicuspid rarely. P_4 does not seem to differ much from that tooth in *C. eximia* either in size relative to M_1 or in structure; there are strong anterior and posterior cusps and a strong posterior cingulum which is prolonged into a narrow internal shelf. In the holotype the anterior cusp is stronger than in *C. eximia* and does not differ from *C. carnifex* but in the referred ramus (D 163) P_4 seems to be almost identical with P_4 of *C. eximia* except that the postero-internal shelf is somewhat broader and the tooth tapers more towards the front. Apart from its very slightly superior size it differs from P_4 of *C. carnifex* by its stouter posterior cusp, its narrower internal shelf and the stronger posterior cingulum. P_3 seems not to differ appreciably in size or structure in *C. mordax* and *C. eximia.* In *C. carnifex* it is rather more slender and the anterior accessory cusp is stronger. In *C. gigantea* type, both anterior and posterior cusps seem to be stronger. P_2 hardly differs in *C. mordax* and *C. eximia.* In *C. carnifex* there is a small anterior cusp which is absent in the other two species. There is no trace of P_1, so that even if present it must have calcified too late and probably shed too early to be more than the merest rudiment. On the contrary it is present in *C. eximia.* The first permanent incisor is just about to erupt. The second incisor is far below the level of the gum and the canine still deeper.

Lower milk dentition.—The relative sizes of mm_4 and mm_2 are approximately the same as in the young mandibular ramus of *C. eximia* figured by Gaudry (1863, Pl. xii, fig. 6). Mm_3, the only one of the milk teeth of which the crown is at all preserved, is relatively a little longer than the corresponding tooth in the young jaw of *C. eximia* referred to. The main cusp is broken off, but immediately behind it is an extremely high subsidiary cusp and behind this a cingular shelf elevated into internal and external cusps. The alveolus of mm_1 is clearly visible; this tooth appears to be lacking in *C. eximia.* There is a distance of about 11 mm. between mm_2 and the canine, which is about the same as in *C. eximia.*

Remarks.—It is highly desirable that additional and more complete material of this species should be found before we can decide as to whether it is a distinct species from *C. eximia* or merely a local race of that apparently widely spread and variable species. Either skull or mandible might afford decisive evidence and it is possible that with a larger number of specimens, *C. mordax* might exhibit the same individual or racial variation which we find in *C. eximia.* Of the main characters in which the Indian form differs from the holotype of *C. eximia*, namely: (1) the presence of a metaconid in M_1; (2) the absence of P^1 and P_1; (3) the stronger anterior cusp in P_4; (4) the larger M^1; (5) the shallower ramus, the first three have definitely been observed in races or individuals of *C. eximia*; while as to (3) an identical anterior cusp in P_4 to that in *C. eximia* actually exists in an Indian specimen (D 163), which there seems no reason to separate from the holotype of *C. mordax.* Nos. (4) and (5) alone remain as characters of the Indian form, which, so far as I am aware, have not been observed in any European or Asiatic specimens of *C. eximia.* It is doubtful whether these alone would entitle *C. mordax* to more than racial distinction from *C. eximia.* Provisionally, however, *C. mordax* may take rank as a distinct species. In any case it seems to stand on a line side by side with *C. eximia* and apart from *C. carnifex* and *C. gigantea.* Although it retains certain primitive features which were lost earlier by *C. carnifex,* yet it represents on the whole a higher stage of Hyaenid evolution. This is quite consistent with the theory of successive migrations from an original centre of distribution. So far as we know, *C. carnifex* arrived first, possibly in the Upper Tortonian; then *C. gigantea*, var. *latro* in the Sarmatian with a terminal giant Pontian variety in the Chinese type of *C. gigantea*; finally *C. eximia* and *C. mordax*, possibly reaching Europe and India simultaneously in the Pontian. *C. variabilis* is the corresponding form in China. The latter has apparently more tendency than *C. eximia* to retain the primitive type of protocone in P^4 (Zdansky 1924, p. 96).

CROCUTA sp.

1886. *Hyaena crocuta*, Erxl., Lydekker, *Pal. Ind.*, (10), IV, p. 30, Pl. vii, figs. 13, 13*a*.
1930. *Crocuta* sp., Pilgrim, *Journ. As. Soc. Beng.* Vol. XXVI, Official No., 1930.

Early in 1930, Professor Narayan Rao of the Mysore University called my attention to two fragments of the palate of a hyæna, which a party working under his direction had discovered in an almost denuded alluvial deposit in the Trichinopoly district of Madras. These fragments are the left maxilla containing P^2-P^4 and the alveoli of P^1 and M^1 and the right maxilla containing the canine, P^1 and P^2. These are as yet undescribed, but they obviously differ greatly from the living *Hyaena hyaena*, and are referable to the genus *Crocuta*. Their precise affinities will no doubt be made known by Professor Narayan Rao in a paper which he has in contemplation.

Since the age of the deposit is probably approximately the same as that of the Billa Surgam Cave fauna, it seems likely that the M_1 from the latter deposit, which was described and figured by Lydekker (1886, p. 30, Pl. vii, figs. 13, 13*a*), under the name of *Hyaena crocuta*, may belong to the present species.

Family: *FELIDÆ*.

Diagnosis.—Aeluroidea primitively with long skull, later shortened considerably, face extremely so; rather inflated brain case; alisphenoid canal only present in primitive forms; entotympanic portion of auditory bulla very large, separated by a high septum (occasionally doubtfully so) from the laterally placed, smaller ectotympanic; external auditory meatus short; paroccipital process separated from the mastoid process, stretched out against the hinder part of the bulla; dental formula $\frac{3.1.\ 3\text{-}2.\ 1}{3.1.\ 3\text{-}1\ 1(2)}$; canines strongly developed; M_1 with two converging blades, developed from paraconid and protoconid; primitive forms with strong metaconid, progressively becoming fused with protoconid; talonid only present in primitive forms, trenchant, progressively disappearing; M^1 and M_2 always small; premolar series progressively reduced; humerus usually with entepicondylar foramen; extremities relatively long and slender, digitigrade; manus 5-dactyl; pes generally 4-dactyl; claws retractile, except in *Acinonyx* and allied genera; os penis rudimentary.

Sub-family: *PROAILURINÆ*, Roger (1896, p. 66).

Diagnosis.—Primitive or archaic Felidæ with low face, relatively elongated muzzle, and long, slender, shallow mandible; with a progressive tendency towards a deepening of the mandibular symphysis, but without a mental crest or process; progressive reduction of the molars and of the anterior premolars, but less so than in other Felid subfamilies; progressive increase in length and height and lateral compression of P^4 and M_1; progressive reduction of parastyle in P^4; progressive reduction of metaconid and talonid in M_1; progressive enlargement of canines; in the most advanced members with the accessory cusps of the premolars tending to disappear; retention of certain primitive characters such as a slender mandible; internal cusps and roots in P^2 and P^3; alisphenoid canal present.

Remarks.—In his very able revision of the Carnivora of the Phosphorites of Quercy, Teilhard de Chardin (1915, p. 167) proposed the name Stenoplesictidæ for a collection of genera including in addition to *Stenoplesictis* also *Stenogale, Palaeoprionodon, Leptoplesictis, Palaeogale, Plesictis,* and *Proailurus,* all exhibiting certain adaptations of a Felid nature. It is obvious that Teilhard regarded the group as merely a morphological one, from his phylogenetic diagram (1915, p. 181), in which two divisions are indicated taking their origin at some period antecedent to the Phosphorites: (1) a Viverrid branch; (2) a Mustelid branch. This opinion was probably largely based on the existence of basicranial characters indicative of Viverrid and Mustelid affinities respectively in skulls of *Palaeoprionodon* and *Plesictis.*

Schlosser (1923, p. 474) placed *Plesictis* in the Mustelid subfamily, Martinæ, and united the others in the group of the *Stenoplesictinae,* which without any very apparent reason he classified as a subfamily of the Mustelidæ, Helbing (1928, pp. 45,64) classes *Plesictis* among 'Mustelidæ in the narrower sense' and *Stenogale* and *Proailurus* as 'Feline Mustelidæ'. The Mustelid characters of *Palaeogale* (?=*Bunaelurus*) are moderately clear, but on the other hand those of *Proailurus* and *Stenogale,* as Teilhard has pointed out, tend more towards the Felidæ. Schlosser's procedure, therefore, appears to be illogical. Either the Stenoplesictidæ represent a definite phylogenetic group intermediate between the modern Mustelidæ, Felidæ and Viverridæ and the primitive Creodonta, in which case they should rank as a family of equal value with the Felidæ, Viverridæ. Mustelidæ and Miacidæ; or else the similar characters are no more than parallel adaptations or a modified retention of primitive features, in which case the various Stenoplesictine genera should properly find a place among the primitive members of that modern family to which they most appropriately belong. My separation of *Proailurus* and *Stenogale* as a definite subfamily of the Felidæ is based on the assumption that the latter alternative is correct. Viret (1929, p. 159) has recently insisted on the likeness between *Proailurus* and *Pseudœlurus,* even regarding *Proailurus lemanensis* as ancestral to *Pseudœlurus,* though placing *Proailurus julieni* with the Mustelidæ. Teilhard regards the latter species as a *Stenogale.*

Teilhard, like Filhol (1881, p. 288), finds a descendant of *Proaïlurus* in the living genus *Cryptoprocta,* which Pocock (1916, p. 413) and others *e.g.* Abel (Weber, 1928, p. 322) include in the Viverridæ, but none, so far as I am aware, in the Mustelidæ. In the absence of information as to the fossil history of *Cryptoprocta,* it must be regarded as uncertain whether its Viverrid characters are due to the retention of primitive characters which were shared equally by ancestors of the Felidæ and Viverridæ or later acquired purely Viverrid characters. Viret (1929, p. 160) regards the Proailurine features of *Cryptoprocta* as due to convergence. I personally am more inclined to take the former view, but in any case, I see no reason like Kretzoi (1929, p. 1346) to class *Proailurus* as a Viverrid.

The persistence of the Proailurinæ into the Upper Miocene or later seems to find support in the existence of the genus *Mellivorodon* in the Dhok Pathan stage and of the closely connected genus *Vinayakia* in the Chinji and Nagri stages of India. In my opinion these are archaic survivals entirely comparable to that of the Creodont *Dissopsalis* in the Chinji stage of India. They have none of the special characters seen in contemporary members of the Felinæ or Machærodontinæ, while on the other hand they have developed certain other characters, which are found in no Felid at any epoch. The existence of such characters has made it possible for Lydekker to class *Mellivorodon* as a Mustelid. The subject is discussed in greater detail on page 161, but in conclusion it seems likely that the retention of primitive features and the development of aberrant ones, entitles them to find a place in a subfamily different from both the Felinæ or the Machærodontinæ and since these features may easily be regarded as later developments of some form allied to *Proailurus*, the inclusion of these Indian genera in the subfamily of the Proailurinæ seems provisionally to be the most convenient course to adopt.

Measurements of Indian Proailurinae.

——		*Mellivorodon palaeindicus* (G. S. I. no. D 21).	*Vinayakia nocturna* (G. S. I. nos. D 221 and D 218).	*Vinayakia sarcophaga* (G. S. I. no. D 217).	*Aeluropsis annectans* (G. S. I. no. D 41).
C	ant.-post. diam.	12·0	..	..	..
	trans. diam.	..	..	..	..
P_2	ant.-post. diam.	3·2	12·6	..	..
	trans. diam.	..	6·8	..	..
P_3	ant.-post. diam.	9·2	17·6	..	..
	trans. diam	..	8·3	..	..
P_4	ant.-post. diam.	9·6	..	..	17·0
	trans. diam.	5·2	..	..	7·0
M_1	ant.-post. diam.	..	..	..	app. 16·5
	trans. diam.	6·6	..	..	..

Measurements of Indian Proailurinae—contd.

——	*Mellivorodon palaeindicus* (G. S. I. no. D 21).	*Vinayakia nocturna* (G. S. I. nos. D 221 and D 218).	*Vinayakia sarcophaga* (G. S. I. no. D 217).	*Aeluropsis annectans* (G. S. I. no. D 41).
Breadth of ramus beneath M_1	10·9	..	..	12
Depth of ramus beneath M_1	22·9	app. 31	..	34·5
P^2 ant.-post. diam.	..	15·5	19·8	..
P^2 trans. diam.	..	6·0	10·9	..
P^3 ant.-post. diam.	..	18·9	20·4	..
P^3 trans. diam	..	10·8	11·8	..
P^4 ant.-post. diam.	..	..	..	..
P^4 trans. diam.	..	..	15·7	..

Genus : MELLIVORODON, Lydekker.

1884. *Mellivorodon,* Lydekker, *Pal. Ind.,* (10). II, p. 185.

Diagnosis.—Proailurinæ of large size, with lower border of mandibular ramus straight; symphysis deep; large mental foramina; with very short post-canine diastema; lower premolars reduced both in number and size, rather crowded, with roots extremely large and dilated relatively to the size of the crowns, without definite accessory cusps; P_1 absent; P_2 very small, single-rooted; M_1 very long and narrow, probably with short talonid; lower canine large, oval, not specially compressed.

Genotype.—Mellivorodon palaeindicus, Lydekker (1884, p. 185).

MELLIVORODON PALAEINDICUS, Lydekker.

1878. *Meles* sp., Lydekker, *Rec. Geol. Surv. Ind.,* XI, p. 102.
1884. *Mellivorodon palaeindicus,* Lydekker, *Pal. Ind.,* (10), II, P. 185, Pl. xxvii, figs. 7, 7*a*.

Diagnosis.—As the only known species the diagnosis is that of the genus.

Holotype.—The incomplete left mandibular ramus described and figured by Lydekker (1884, p. 185, Pl. xxvii, figs. 7, 7*a*). It is in the collection of the Geological Survey of India in Calcutta regd. no. D 21.

Locality.—Hasnot, Salt Range.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Remarks.—The holotype of this species was clearly stated by Lydekker to be the ramus G. S. I. no. D 21, in which the crown of M_1 is poorly preserved and lacks the talonid and everything behind this; but his description and his views as to the taxonomic position of the species were largely based on a second mandibular fragment, G. S. I. no. D 22, containing the poorly preserved M_1

and the alveolus of M_2 only, which he referred to the same species. The talonid of this specimen is moderately well preserved. I have stated above (page 71) my reasons for disagreeing with Lydekker's reference of D 22. The two specimens are undoubtedly not conspecific. While I consider, like Lydekker, that D 22 is Mellivorine and allied to the Chinji species *Eomellivora* (?) *necrophila* sp. nov. (the specimens of the latter being unknown to Lydekker), I agree with Matthew (1929, p. 467) that the affinities of the holotype D 21 are rather Felid than Mustelid. While Matthew, having only the one specimen under his observation, was unable entirely to reconcile the absence of posterior cusps on the premolars with its otherwise marked Felid resemblances, I have the advantage of several additional specimens from the Chinji and Nagri stages, which undoubtedly belong to a closely allied, but more primitive form than *Mellivorodon palaeindicus.* These are described below (pages 158-164) under the names of *Vinayakia nocturna* and *Vinayakia sarcophaga.* In these the lower premolars are less reduced, more spaced, and the heels much more prominent, but still without definite accessory cusps. The other Felid resemblances are just as marked, but are more reminiscent of the Oligocene genus *Proailurus* than of the more recent Felids. Especially striking are the well developed internal lobe and the internal root in P^2 and P^3 and the tall prominent parastyle in P^4, which are more characteristic of *Proailurus* than of any later Felid genus. The strong roots of the anterior premolars in *Mellivorodon palaeindicus,* which are altogether disproportionate to the size of the crowns, are especially noteworthy and seem to indicate that the Dhok Pathan species was a degenerate descendant of a larger and more primitive form. I do not suggest that either of the two known species of *Vinayakia* was its direct ancestor, as both of them are too big, but another smaller, still undiscovered species of *Vinayakia* might easily fill the required place.

Genus: VINAYAKIA[1], nov.

Diagnosis.—Proailurinæ of extremely large size; with low, narrow face; orbit lying rather far forward, infra-orbital foramen with a large anterior opening lying in a deep depression; lower border of mandibular ramus slightly concave; symphysis deep and very steep; two mental foramina beneath P_2 and another beneath P_3; canine with crown unknown but with long root; lower premolars not specially reduced in size; rather spaced, with diastemata behind the canine and between P_2 and P_3; P_1 absent; P_2 and P_3 double-rooted, elongate, with rather low, compressed main cusps, which slope down at first steeply then very gradually to the anterior and posterior ends, thus producing a heel, which, however, has no cusp; anterior accessory cusp also absent; roots very stout and dilated below the tooth crowns; P^4 rather compressed, with high pointed protocone, situated very internally but not much extended in an antero-posterior direction; parastyle extremely high and sharp-pointed; P^2 and P^3 similar in outline and profile to P_2 and P_3 but with well developed internal expansion, not surmounted by a definite cusp, but standing on a separate root (in one species in P^2 this root is fused with the adjacent main posterior one).

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[1] This name is given to the genus in honour of my friend and colleague Rao Bahadur M. Vinayak Rao and as a slight mark of appreciation of his work amongst the Siwalik deposits and of the large number of fossil forms which that work has been instrumental in adding to the Indian fauna.

Genotype.—*Vinayakia nocturna*, sp. nov. described and figured below (Pl. iv, figs. 2, 4, 4*a*).

Species.—In addition to the genotype, an equally large but more primitive species, *V. sarcophaga*, sp. nov. occurs at a lower horizon.

VINAYAKIA NOCTURNA, sp. nov.

(Pl. IV, figs. 2, 4.)

Diagnosis.—A *Vinayakia* of large size, about midway between *Panthera pardus* and *tigris*; with anterior premolars more reduced and with shorter heels than in *V. sarcophaga*; P^3 with internal expansion slightly less prominent than in *V. sarcophaga*; P^2 with internal expansion considerably less prominent and situated more to the rear than in *V. sarcophaga* and internal root fused with adjacent posterior one.

Holotype.—The right mandibular ramus described and figured in this work (Pl. iv, figs. 4, 4*a*). This is in the collection of the Geological Survey of India in Calcutta regd. no. D 221.

Referred specimen.—A fragmentary right maxilla (G. S. I. no. D 218) containing P^3 and P^2, described below and figured in Pl. iv, fig. 2.

Locality.—The type locality is two miles N. 35° E. of Kadirpur, Attock district, Salt Range. The referred maxilla was collected near the village of Bahitta 1½ miles S. E. of Padhri and Hasnot.

Horizon.—The holotype belongs to the Nagri stage of the Middle Siwaliks. The referred maxilla is probably at a lower level than that from which the bulk of the species of the Dhok Pathan stage was obtained, but is unlikely to be as low as the Nagri stage from which the holotype came.

Description.—The holotype is a fragment of the right mandibular ramus containing the perfect P_2 and P_3, the alveolus of the front root of P_4 and part of the alveolus of its hinder root, also the hinder end of the alveolus of the canine. The premolars are in a moderately advanced stage of wear and the tips of the main cusps have been removed, leaving small circular pits. Their roots are exposed for a considerable distance below the base of the crown, but this does not seem to be due altogether to weathering, since the upper surface of the ramus behind the alveolus of the canine bears no sign of erosion. It follows, therefore, that the crowns have been unduly pushed up above the level of the alveoli. That this is so is indicated by a precisely similar condition in all the specimens both of *V. nocturna* as well as *V. sarcophaga* and also in the holotype of *Mellivorodon palaeindicus*. This can hardly be a coincidence, and is perhaps to be correlated with the rapid degeneration of the premolars unaccompanied by a corresponding reduction of the roots.

There is a diastema of about eight mm. behind the canine and one of about four mm. between P_2 and P_3, and probably a small one between P_3 and P_4.

The existence of these diastemata and a comparison with the referred maxilla and that of *V. sarcophaga* shows that P_1 must be missing, and that the numbering of the premolars is as stated above. Even so the ramus was evidently extremely long and shallow and relatively slender. There are two mental foramina beneath P_2, of which the anterior one is much the larger, and a third beneath P_3. The symphysis, as shown by the hinder end of the suture, descended continuously and steeply to a level with the hinder end of P^2 and is very deep. The lower border of the ramus is slightly concave beneath P^3, the ramus deepening in front of and behind this limit. The lower surface is rounded or keeled, not flattened. The root of the canine seems to have been large and long. P_2 is an elongate tooth with an oblong outline and a low crown. The profile is regular but gentle from the summit of the main cusp to the anterior margin, there being no anterior cusp. The posterior profile is slightly concave, flattening somewhat at the posterior end, but without any trace of an accessory cusp. There is the faintest indication of a keel running from the summit to the margin. P_3 is almost half as large again as P_2 and has a much higher crown. The profile is similar to that of P_2, but the anterior edge is slightly concave, while the posterior one is much more strongly so, producing a more extended flattened area, but in neither case are accessory cusps present. The keels are more pronounced than in P_2. The roots of both premolars are extremely stout, and dilate as they descend into the ramus. P^4 seems to have been more than half as large again as P_3 and to have been very much stouter.

I cannot doubt that the referred right maxilla (G. S. I. no. D 218), if not actually the same species as the holotype, represents so trifling a mutation of it that it is inexpedient to separate the two. They correspond almost exactly in size, the Bahitta P^3 being only very slightly too short to correspond with the Kadirpur P_3. It is possible that this difference represents an advance in the reduction which I believe to be in progress in the phylum, which indeed might be expected on account of the somewhat higher horizon of the referred maxilla, but to recognize it, even if conclusively proved, would serve no useful purpose with such fragmentary material. Not only do the upper premolars possess the same unusually powerful dilated roots as the lower premolars of the holotype, but the profile of the crowns is identical in both. The posterior keel is slightly more pronounced in P^3 than in P_3, but the difference is probably due to weathering. The posterior flattened heel is also present in P^3, and in this case also without any definite cusp. The outline is very similar except that the hinder end of P^3 is narrower and more tapering than in P_3. It may also be mentioned that the main cusps of the upper premolars have weathered into a curious crater-like form, which precisely reproduces the appearance not only of the lower premolars from Kadirpur but also of those of the ramus of *Mellivorodon palaeindicus* and of the upper premolars of *Vinayakia sarcophaga* (p. 162). I do not remember to have observed this peculiar type of weathering in any other carnivorous teeth, and its occurrence in these various allied specimens seems likely to be significant, and to indicate that the teeth of this group possessed some peculiarity either of the enamel or dentine which caused them to weather in this abnormal fashion.

As to the position in the jaw of the two premolars of the maxilla, the following points indicate that they are P^2 and P^3. Behind the larger of the two teeth there is a large curved margin to the inside of the tooth row; this is undoubtedly the weathered alveolus of the root which supported the protocone of P^4; immediately above the hinder tooth is the extraordinarily large infra-orbital foramen, which also implies that the tooth is P^3; the strong outward curvature of the maxilla opposite the foremost of the two teeth indicates that the canine was very near so that any tooth in front of it must have been very small; it cannot be asserted that such a tooth did not exist but a vestigial P^1 would not necessarily militate against the association of the ramus and the maxilla, especially as there is a long diastema in the former between P_2 and the canine.

One of the most remarkable features of P^3 is the presence in the middle of the internal side of a marked expansion at the base of the crown. This expanded area is not surmounted by any sort of cusp, but it stands on a well developed third root, which is almost as strong and quite as much dilated as the other two roots. The crown of P^2 is somewhat broken, but it shows a very similar expansion, only less pronounced than in P^3 and situated more to the rear. Moreover the third root is fused with its fellow of the posterior end of the tooth. The posterior flattened heel seen in P^3 is practically absent or at any rate much smaller in P^2; a break in the posterior profile does not permit us to say which. The alveolus behind P^3 indicates that P^4 probably had a narrow blade and a protocone which was extended very far to the inside of the paracone. The position of the large infra-orbital foramen indicates that the maxilla was probably low, so that the face must have been much lower as it was also certainly much more elongate than in modern Felidæ.

Comparisons.—The affinity between this species and *Mellivorodon palaeindicus* can hardly be doubted, in spite of their great difference in size. In both, the premolars have similar strong dilated roots and though reduced in *Mellivorodon* display a very similar elongate outline and a low crown. The profile of the premolars in *Mellivorodon* is not unlike that which we find in *Vinayakia*, allowing for the assumed degeneration which the former genus has undergone. Although the flattened heel of P_3 in *Vinayakia* is not found even in P_4 of *Mellivorodon*, yet P_4 of the latter much more nearly resembles P_2 of the former than either of them approaches any other form I know. In neither case are there any accessory cusps, though even here the posterior profile is slightly more gentle and more concave in *Vinayakia* than in *Mellivorodon*. In both cases the premolars are spaced, unlike what we find in the Mustelidæ or Viverridæ, and P_1 has been lost, a reduction which, though occurring in many modern Mustelidæ, is not found in members of that family which are contemporary with the two Indian genera now being dealt with.

These resemblances between *Mellivorodon* and *Vinayakia* are one of the main reasons for the opinion expressed above (page 157) that *Mellivorodon* is a highly degenerate descendant of some form allied to *Vinayakia nocturna.*

Although the large canine, the long carnassial, the large roots and the large mental foramina have been retained, yet the jaw has been shortened considerably; the premolars have become reduced and have lost even the flattened heel of *Vinayakia*. As will be pointed out below (page 164) *Vinayakia nocturna* is itself reduced when we compare it with the Chinji species *V. sarcophaga*. The mandible of the latter species is unfortunately not known but I have little doubt that either in it, or a still earlier species, P_1 would be found and P_4 would possess a posterior cusp on the heel.

It is unfortunate that neither this nor the following species provide us with any but the most incomplete clue to the structure of the upper and lower carnassial teeth. It is, however, interesting that a fragmentary M_1 from the Kamlial stage of Sind (G. S. I. no. D 220) described and figured in this work (page 164, Pl. iv, fig. 13) should show precisely the characters which we find in the corresponding tooth of *Proailurus*, *Stenogale* or *Aelurictis*, while agreeing in size with the ramus of *Vinayakia nocturna*. Although I cannot venture definitely to refer it to *Vinayakia*, yet its existence in the Indian deposits tends to lend some support to the view as to the affinity of *Vinayakia* which I advocate.

Matthew (1929, p. 467) has already pointed out the Felid characters of the mandible of *Mellivorodon palaeindicus*, and the discovery of *Vinayakia* puts these in a stronger light not only intrinsically but also when we view the three known forms as a phylogenetic series. At the same time we have to go back to Oligocene species like *Proailurus lemanensis*, *Stenogale julieni*, and *Aelurictis edwardsi* and *helbingi* (Kretzoi 1929, p. 1295), possibly congeneric with *Proailurus* (*see* Teilhard 1915, p. 82) to find Felid forms which have an equally slender, shallow and elongate mandible, and the same comparatively long, compressed carnassials, with the premolar series much less reduced than in the more modernised lines of the Felidæ. In the deepening of the symphysis *Vinayakia* has followed the course of evolution taken by many more recent Felid lines, but in the retention of an internal expansion of P^2 and P^3, it has diverged from all Miocene and Pliocene Felinæ and Machærodontinæ. Many modern Viverridæ such as *Herpestes* and some Hyænidæ show a somewhat similar expansion and in a less degree even some Mustelidæ, but in the Oligocene *Proailurus*, in *Hyainailouros* and in the recent Madagascar genus *Cryptoprocta* alone do we see an actual third root retained. In them as in *Vinayakia*, I consider that the internal lobe is a relic of a primitive condition regularly found in the Viverravidæ and other Creodont families. The loss of the accessory cusps of the premolars is equally not a Feline or Machærodontine character and this feature in *Vinayakia* seems to indicate that it represents an aberrant line which continued the development of *Proailurus* after it had died out in Europe. This and the deep symphysis definitely remove this line from any save the remotest connection with the Viverridæ. *Cryptoprocta* is evidently an equally aberrant line, but on the strength of the retention of one or two primitive features it would be rash to assume that it has any real affinity with the Indian genera which we are now considering, even should it be shown to have any with *Proailurus*. The increase in the reduction of the anterior premolars as we ascend in the time scale from *Vinayakia sarcophaga* to *Vinayakia nocturna* (see page **164**), seems to be a weighty argument in favour of the hypothesis that the two species represent successive stages in the degeneration of a group, and further that *Mellivorodon palaeindicus* is yet a third stage of the same degeneration, characterised by a still further reduction of the anterior premolars accompanied by an actual shortening of the jaw. In addition to the existence of the third root in P^2 and P^3; the long low face; the hypsodont teeth; the compression of P^4; and the reduction in length of the parastyle seem to take us back to some form that may have been allied to *Proailurus.* Unfortunately intermediate stages are lacking, but I imagine that we have before our eyes the last members of an aberrant line, in which originally the parastyle in P^4 was much stronger and higher, while the premolars were much longer than in *Proailurus* but had equally strong accessory cusps, and agreed with the Oligocene genus in having a comparatively long, high, narrow carnassial, and an elongated slender muzzle. Subsequently reduction began in much the same direction as in the *Proailurus* branch, but proceeded much farther; the anterior premolars actually lost their accessory cusps, until as a final stage of degeneration the jaw shortened as we find it in *Mellivorodon.* There are many features in this scheme of evolution which are paralleled by the Felinæ, but in the *Vinayakia* phylum they have taken place more slowly and were accompanied by certain aberrant developments which clearly separate these forms from the subfamily of the Felinæ.

VINAYAKIA SARCOPHAGA, sp. nov.

(Pl. IV, fig. 5.)

Diagnosis.—A *Vinayakia* of about the same size as *V. nocturna*; with anterior premolars less reduced than in that species; P^3 with a longer, flatter heel and internal expansion slightly more prominent; P^2 with internal expansion more prominent, and occupying a more median position than in *V. nocturna*; with its internal root quite distinct from the adjacent posterior one.

Holotype.—The associated left and right maxillæ, the former with P^3 and the front portion of P^4 and the latter with P^2 only, figured in Pl. iv, figs. 5, *5a-c* of the present work. The specimens are in the collection of the Geological Survey of India in Calcutta regd. no. D 217.

Locality.—These were found by Vinayak Rao south of Kotal Kund, Jhelum district, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The left maxilla has a part of the palate preserved, containing the perfect P^3 and the front portion of P^4, both in a comparatively early stage of wear with the summits of the cusps just removed, leaving a small pit. The hinder part of the alveolus of P^2 is also present. A small portion of the lower rim of the orbit is seen, situated 29 mm. above the base of the crown of P^4, and probably extending forward to a level with the hinder half of P^3. In front of and below the orbit the infra-orbital foramen lies in a large depression, about 23 mm. above the base of the crown of P^3. The base of the zygomatic process of the jugal does not appear to be directed outward very noticeably, nor to overhang the teeth.

Of P^4 only two cusps remain in front of the fracture which has unfortunately deprived us of the knowledge of the whole of the hinder part of the tooth, including the posterior root, known only by the extreme front edge of the alveolus. Of these two cusps, one is the protocone, which lies well to the inside of the outer cusps, but only slightly more so than the internal expansion of P^3. Its front edge is quite on a level with the antero-external corner of the tooth, so that the front border is strongly concave in outline. The cusp of the protocone is well marked but low and is separated from the shear by a very shallow depression. Its antero-posterior diameter is small and seems to remain the same until it meets the main anterior shear, not broadening out in the way we find in most genera of the Felidæ and Viverridæ. The outer cusp is very nearly twice the height of the protocone, and is clearly delimited by a small circle of wear, the profile descending on either side from its summit, very steeply on the anterior side, less steeply posteriorly; the fracture, however, prevents us following it more than a very small distance in the latter direction. This cusp is evidently not the paracone, as may be inferred not only by the fact that it is slightly lower than the main cusp of P^3, but also because it only covers the anterior half of the antero-external root which is well preserved. It follows that the paracone must have been a much higher cusp, now broken off, and that the anterior cusp which we see is the homologue of the parastyle, relatively short but having an unprecedented height, to which I have found no parallel elsewhere. Judging by the relative size and position of the roots, I should estimate that the length of P^4 was about 25 mm. or only about one quarter as long again as P^3, so that it was probably relatively shorter than in *Proailurus* or *Aelurictis.* The blade was evidently extraordinarily narrow compared with that of most of the modern lines of Carnivora.

The second fragment is a right maxilla found in the same spot as the left maxilla and evidently a part of the same individual, an assumption borne out by its entire agreement in general structure and stage of wear as well as by its identical state of fossilisation. That the solitary tooth which it contains is P^2 is proved both by the fact that it is slightly smaller than the left P^3 and also by its slightly more advanced stage of wear and in addition by the situation of the inner expansion of the base of the crown, which lies more to the rear than in P^3, thus corresponding with its relative position in these two teeth of *Vinayakia nocturna.* Except for the character mentioned the P^2 is very similar to P^3. As has been said it is slightly smaller. The posterior heel is also shorter, but the internal expansion is equally pronounced and the third root on which it stands is equally distinct.

Comparisons.—The affinity of this species to *Vinayakia nocturna* is obvious at a glance. That it is of approximately the same size is taken as proved by the fact that the infra-orbital foramen is situated at the same distance above the base of the crown of P^3 as in the maxilla (G. S. I. no. D 218) referred to *V. nocturna.* On this assumption it appears, as may be seen in the table of measurements on page 156, that the anterior premolars are considerably less reduced than in *V. nocturna*. The heel in P^3 is longer, the anterior profile is slightly concave instead of straight. In P^2 the difference between the two species in regard to the degree of reduction is very much more marked than in the case of P^3, not only in actual length but also in structural features. The heel is considerably longer than in *V. nocturna*; the internal expansion lies much farther forward and is more pronounced; and the third root is quite distinct instead of being fused with its fellow.

Genus Indet.; sp. A. indet.; sp. B. indet.

(Pl. IV, figs. 3, 13.)

There are two fragmentary specimens of M_1, which it is quite useless to name specifically, but which I have thought it desirable to describe and figure because they conform very nearly to what is probably the type of M_1 which a genus like *Vinayakia* possessed. They are equally not unlike the hypothetical M_1 which Matthew (1929, p. 468, fig. 5) thought might have belonged to *Mellivorodon*.

The specimens in question are G. S. I. no. D 219 from the Chinji stage of Chinji, figured in Pl. iv, figs. 3, 3*a* of the present work and G. S. I. no. D 220 from the Kamlial stage of Bhagothoro, Sind, figured in Pl. iv, fig. 13 of the present work. D 219 is a short, rather stout, high-crowned tooth, lacking the front of the paraconid. The paraconid is inclined at a considerable angle to the protoconid and is separated from it by a deep notch. The blade of the protoconid slopes forward from the high, pointed summit at an angle of about 45°. Its posterior edge is almost vertical and shows a slight indication of an original crenulation. There is no definite trace even of a rudimentary metaconid. Behind the protoconid is a short talonid, partly broken on the internal side which rises to a sharp cusp at the rear, separated from the protoconid by a low descending ridge on the outer side and on the inner side by a concave valley. The antero-external corner shows a much worn but originally well marked cingulum. The character of this tooth is altogether Felid, but of a very primitive type, reminding one somewhat of *Dinictis*. Its robustness and size make it unlike the M_1 of *Proailurus* or *Aelurictis*. These characters added to the crenulated edge of the protoconid suggest that it may be some primitive Machærodont.

The other specimen D 220 possesses much more the characters which might be expected in the M_1 of *Vinayakia*. Only the extreme hinder end of the tooth is preserved. The protoconid is as high as in D 219 and has an equally vertical hinder edge, on which the existence of crenulations can be traced. Here, however, there is a distinct rudiment of a metaconid. The talonid is shorter than in D 219 but is quite similar in structure. The tooth is also much more compressed laterally. A slight cavity behind it may or may not be that of the alveolus of a rudimentary M_2. The size of the ramus corresponds as nearly as may be to that of *Vinayakia nocturna*, and the characters of the M_1 so far as they can be seen agree with those of the corresponding tooth of *Proailurus* or *Stenogale*, except that it considerably exceeds it in size. The existence of such a tooth as this, even though in an earlier stage than that of Chinji, is in some small degree evidential for the views expressed above as to the affinities of *Vinayakia.*

INCERTÆ SEDIS.

Genus : AELUROPSIS, Lydekker.

1884. *Aeluropsis*, Lydekker, *Pal. Ind.*, (10), II, p. 316.

Diagnosis.—Felidæ with a long jaw ; deep ramus ; probably with a mental process ; cheek teeth probably not crenulated ; premolars probably not reduced ; P_4 longer than M_1, with low but well developed anterior and posterior accessory cusps and a prominent posterior cingulum ; M_1 short, possibly with a metaconid, with a relatively long talonid ; M_2 present.

AELUROPSIS ANNECTANS, Lydekker.

1884. *Aeluropsis annectens*, Lydekker, *Pal. Ind.*, (10), II, p. 316, Pl. xxxiii, figs. 4, 4*a*.
1929. *Aeluropsis annectens*, Matthew, *Bull. Amer. Mus. Nat. Hist.*, LVI, p. 496, text. fig. 29.

Diagnosis.—The diagnosis is that of the genus.

Holotype.—The fragmentary left mandibular ramus described and figured by Lydekker (1884, p. 316, Pl. xxxiii, figs. 4, 4*a*). It is in the collection of the Geological Survey of India in Calcutta regd. no. D 41.

Locality.—Hasnot, Salt Range.

Horizon.—Presumably the species belongs to the Dhok Pathan stage of the Middle Siwaliks, it being unlikely, even if the holotype had been brought to Theobald by a villager, that it would have been collected far from Hasnot village.

Remarks.—The holotype has been described by Lydekker (1884, p. 316), and further comments on it have been made by Matthew (1929, p. 496). Lydekker interpreted the alveoli in front of P_4 as those of a single, long tooth which would be P_3. Matthew suggested that the portion of the front alveolus which is preserved belongs to P_2, and that P_3 is a shorter tooth than Lydekker supposed. This seems to me much more probable. Although there is a large mental foramen under P_3, there may have been another farther forward. The ramus seems to have been much longer than the fragment preserved, since there is no trace of the root of the canine. If, as Matthew apparently thinks, there was no mental process, the descending border of the ramus beneath P_3 is a peculiar character. The complete absence of the crown of M_1 makes it difficult to be sure whether a metaconid existed or not, but from the fact that the maximum breadth of the tooth lies in front of the talonid, it is probable that there was a metaconid, though it may have been rudimentary. Compared to the length of the tooth the talonid must have been long. The character of the specimen clearly points to Felid affinities, but equally, as Matthew states, to a very primitive stage of evolution comparable to *Proailurus* and *Aelurictis.* I hardly think that Matthew can be right in attributing it to the same genus as *Sivælurus.* since M_1 is relatively too short and P_3 too long. There is, however, some reason to believe that P^4 and M_1 were short in the genus *Vinayakia.* The depth of the ramus would also resemble that of *Vinayakia* rather than *Proailurus* or *Aelurictis*. As has been shown above there are some reasons for regarding *Vinayakia* as a peculiar branch arising from *Proailurus*, and I, therefore, place this species provisionally in that subfamily, but the fragmentary condition of the holotype prevents any definite conclusions from being drawn as to its actual taxonomy.

Sub-family : *HYÆNÆLURINÆ.*

Diagnosis.—Felidæ of gigantic size, which while maintaining an extraordinarily primitive condition in regard to the length of the face and muzzle, and the premolar structure, especially that of the anterior upper premolars, have suffered a reduction of the molar series, entirely comparable to that followed by other Felidæ. Concurrently with this, the jaw and all the teeth have become extraordinarily massive and powerful. Canines very large; upper canines slightly larger than the lower; but little compressed laterally as compared with most Felidæ; with posterior keel fairly well developed and slightly curved; anterior keel absent; I^3 with strongly convex outline in front, and very concave outline behind but without any trace of a basal swelling; upper premolar series complete; with a short post-canine diastema; P^1 two-rooted; P^2 and P^3 three-rooted with a broad inner lobe and strong accessory cusps, in both cases progressively weakening; P^4 short relatively to the anterior premolar series; with high paracone; relatively long trenchant metacone; well developed parastyle, progressively weakening; strong protocone, situated in advance of the outer cusps and widely distant from them internally; M^1 unknown, probably reduced; lower premolar series reduced to a two-rooted P_3 and P_4; with a long post-canine diastema; P_3 simple, conical with accessory cusps absent; P_4 with high conical main cusp, extremely high and prominent anterior accessory cusp, and much smaller somewhat trenchant posterior accessory cusp, extended on the inner side so as to partially embrace the hinder end of the main cusp; M_1 with the two main cusps in the more primitive forms forming a shear with high somewhat pointed summits; progressively tending to become more horizontal and blade-like; protoconid longer than paraconid; heel (=metaconid) small, rather trenchant in primitive forms, progressively diminishing, in the most advanced form absent or reduced to the merest rudiment; M_2 absent.

Subfamily type.—*Hyainailouros sulzeri*, Biedermann (1863, p. 20, Pls. iv, v; 1868, Pls. iii, iv).

Remarks.—Helbing (1925, pp. 214-245), as a result of his detailed and illuminating study of the forms attributed by him to the genus *Hyainailouros*, concluded that they showed affinities both to the Felidæ and the Hyænidæ, but presented such marked differences from both as to entitle them to be classified in a distinct family. My inclusion of them as a subfamily of the Felidæ is by no means intended to be in serious opposition to Helbing's decision on the taxonomy, but merely because it seems more convenient to associate what is obviously a highly aberrant group with the primitive members of a recognized family. I feel all the more inclined to adopt this procedure, because of the existence in the Tortonian and Sarmatian beds of India of such a form as *Vinayakia,* made known for the first time in the present work. This genus possesses certain characters quite reminiscent of those seen in *Hyainailouros,* and more complete material might increase them. With more reason I regard *Vinayakia* as a representative of an aberrant branch descended from extremely primitive Felidæ, which I conceive to have been related to some form like *Proailurus. Hyainailouros* may have taken its rise from an even earlier root than *Proailurus.* Thence it obviously specialised in many ways quite distant from *Vinayakia,* but not indicative of any real affinity with the Hyænidæ, the resemblances being due, in my opinion, merely to convergence. The earliest known Hyænidæ are probably contemporaneous with, or at any rate no earlier than the earliest forms of *Hyainailouros,* and show characters which are entirely remote from those of *Hyainailouros* or the contemporary Felidæ, chiefly evidenced, so far as our present knowledge goes, by the molar dentition, while the resemblances seem to be entirely of the nature of survivals of a primitive length of jaw and of the original type of premolar dentition. The new Vindobonian species of *Hyainailouros, H. lahirii,* described in this work, seems to carry on the evolution of the genus on lines which are even more akin to those followed by the Felidæ as a whole, and so add some support to the classification adopted.

Genus : HYAINAILOUROS, Biedermann.

1837. *Harpagodon,* H. von Meyer *nom. nud., Neu. Jahrb. f. Min. etc.* 1837, p. 675.
1863. *Hyainailouros,* Biedermann, Petrefacten aus der Umgegend von Winterthur, part II, Die Braunkohlen von Elgg, p. 20, Pls. iv, v.
1907. *Hyaenœlurus,* Stehlin, *Bull. Soc. Geol. France* (4), VII, p. 525.

Diagnosis.—This is the only genus known, and the diagnosis is that of the subfamily.

Genotype.—*Hyainailouros sulzeri,* Biedermann (1863, p. 20, Pls. iv, v; 1868, Pls. iii, iv).

Species.—In addition to the genotype, Helbing has mentioned other allied forms from Europe, which he apparently regards as distinct, but to which he has not given specific names. Of the various specimens mentioned by Helbing the only one for which a specific name exists is the P^4 from Mosskirch, Baden, mentioned without detailed description or figure by H. von Meyer (1837, p. 675; 1838, p. 413) under the name of *Harpagodon maximus.* This is perhaps not specifically distinct from the genotype. A mandibular ramus described by myself (Pilgrim 1912, p. 7, Pl. i, figs. 1, 1*a*,) under the name of *Pterodon bugtiensis* has been shown by Helbing to belong to the genus *Hyainailouros.* This is certainly distinct specifically from the European forms. In the present work the species *Hyainailouros lahirii,* sp. nov. is described for the first time.

Remarks.—While all the Felidæ contemporary with *Hyainailouros* have not only a shorter face and muzzle with a more reduced upper premolar series, but also more brachydont teeth and more blade-like carnassial shears, yet in both these respects a similar condition to that which exists in *Hyainailouros* may be found in the Oligocene Felidæ of the type of *Proailurus* and *Aelurictis.* It is true that in the case of the latter the jaw, canines and cheek teeth are slender and so differ considerably from the robust build which characterises them in *Hyainailouros,* but it cannot be regarded as unreasonable to suppose that this character has been specially developed along this branch. On the other hand the gradual evolution of the high, pointed cusps of the carnassial into the typical shear of the recent Felidæ, with the gradual loss of the metaconid is entirely comparable with Felid development. The existence of a third root with a strong accompanying inner lobe in P^3 is, as Helbing has pointed out, a character which occurs outside the Creodonta only in *Proailurus* and some allied genera and in the living *Cryptoprocta.* In *Hyainailouros* this third root and lobe also exists in P^2, but it weakens progressively from the Aquitanian species of Artenay, Sables de l'Orléanais to the Vindobonian species of Veltheim, Winterthur. It is interesting to find in the Chinji and Nagri Indian genus *Vinayakia* an entirely analogous root and inner cusp in P^2 and P^3, the third root in the case of P^2 becoming fused with the main posterior root as we pass from the Chinji *Vinayakia sarcophaga* to the Nagri *V. nocturna.* The progressive reduction in the lower premolars of this genus is certain, and the extraordinarily large, dilated roots point to the existence of an evolutionary stage previous to that of Chinji, in which the premolars were more robust than in *Vinayakia sarcophaga* and the diastema longer, corresponding to a longer jaw and muzzle. The accessory cusps which were probably originally present in the premolars of *Vinayakia* seem to have been lost by the Chinji stage. P^4 of *Vinayakia* seems by its relative shortness and general structure to present some analogies to *Hyainailouros* though, apart from its greatly inferior absolute size and slenderness, the height of the parastyle is an important distinguishing character. There are in fact some rounds for regarding *Hyainailouros* and *Vinayakia* as representatives of two parallel branches, which while retaining many like survivals of a primitive ancestral condition, have diverged considerably in other ways. Both forms seem to supply mutually complementary evidence for a Felid ancestry.

HYAINAILOUROS BUGTIENSIS (Pilgrim).

1912. *Pterodon bugtiensis,* Pilgrim, *Pal. Ind.* N. S. IV, Mem. 2, p. 7, Pl. i, figs. 1, 1*a,* 1*b.*

1925. *Hyænælurus bugtiensis* (Pilgrim), Helbing, *Eclog. Geol. Helv.,* XIX, No. 1, p. 238, figs. 12 *a-c.*

Diagnosis.—A *Hyainailouros* of larger size than *H. sulzeri*; with a steeper anterior edge to the paracone of M_1 and a more horizontal and blade-like upper crest; hinder end of M_1 broader on account of a marked projection of the outline on the inner side; heel (=metaconid) stronger and more trenchant.

Holotype.—The right mandibular ramus containing M_1 and P_4 described and figured by Pilgrim (1912, p. 7, Pl. i, figs. 1, 1*a,* 1*b*) under the name of *Pterodon bugtiensis.* It is in the collection of the Geological Survey of India in Calcutta regd. no. D 107.

Referred specimens.—The mandibular symphysis (G. S. I. no. D 112) described and figured by Pilgrim (1912, p. 8, Pl. ii) may provisionally be placed here.

Locality.—Kumbhi, Bugti Hills, Baluchistan.

Horizon.—The Bugti stage of the Upper Gaj series.

Remarks.—The holotype was fully described and figured by myself (Pilgrim, 1912, p. 7, Pl. i, figs. 1, 1*a*, 1*b*) and restored in outline by Helbing (1925, p. 239, figs. 12, *a-c*). The latter author pointed out that the proportionate dimensions of the two teeth in the holotype differed somewhat from those of M_2 and M_3 of *Pterodon*, to which position and genus they had been attributed originally. On the contrary they agreed so closely with P_4 and M_1 of *Hyainailouros sulzeri* Biedermann, that the reference to that genus seemed certain. The Bugti species belongs to an earlier geological horizon than *H. sulzeri.* It shows a more primitive stage by the longer and more prominent heel (=metaconid) of M_1. On the contrary the more blade-like character of the paraconid, much more nearly approaching that of the typical Felidæ, seems to be indicative of a more advanced stage of evolution.

The right maxilla (G. S. I. no. D 108) which was referred by Pilgrim (1912, p. 9, Pl. i, fig. 2) to *Pterodon* sp. contains only a single complete tooth, which, since the grounds for regarding it as Creodont have been disposed of, can only be P^4 of an ordinary Carnivore. It bears no resemblance to P^4 of *Hyainailouros*, the latter being a much shorter tooth with a more prominent and inwardly situated protocone (*see* Helbing, 1925, pp. 216, 222). On the other hand it is not unlikely to belong to the genus *Amphicyon*, though perhaps rather larger than would correspond with the holotype of *A. shahbazi.* Further remarks on this specimen will be found on page 22 of this work.

The lower premolar (G. S. I. no. D 109) described and figured by Pilgrim (1912, p. 9, Pl. i, fig. 3) under the name of *Pterodon* sp. is equally unlike the lower premolars of any European form of *Hyainailouros*, through the possession of a strong posterior cusp. Its position must remain uncertain.

HYAINAILOUROS LAHIRII, sp. nov.

(Pl. III, fig. 12.)

Diagnosis.—A *Hyainailouros* of larger size and with relatively much stouter jaw and teeth than in other species; M_1 with an absolutely smaller antero-posterior and an absolutely greater transverse diameter than in *H. bugtiensis*; having the notch between the protoconid and the paraconid at a lower level on the crown than in the other species; protoconid with vertical posterior edge; heel (metaconid) absent or rudimentary; paraconid lying more obliquely in relation to the axis of the protoconid, so that the external outline is much more convex; P_4 similar in relative dimensions to M_1 as compared with *H. bugtiensis*; with anterior and posterior accessory cusps, especially the anterior one, situated much more to the inside of the main cusp than in the other species, so that the external outline is extremely convex.

Holotype.—The right mandibular ramus containing M_1 and P_4 figured in Pl. iii, figs. 12, 12*a*, 12*b* of the present work. It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 236.

Locality.—The specimen was collected by H. M. Lahiri about one mile N. W. of the village of Phamra Khalsa, Attock district, Salt Range area.

Horizon.—The Kamlial stage of the Lower Siwaliks.

Description.—The holotype shows the base of the coronoid process but lacks its summit as well as the angle and the condyle. The lower border of the ramus is also broken away. Two teeth are present, both of them considerably worn and damaged in their anterior halves. Nothing of the ramus is preserved in front of these. The absence of any sign of a root behind the two large teeth shown indicates that these teeth are the last in the jaw. On the analogy of *Hyainailouros sulzeri* they will be designated M_1 and P_4 respectively. The lower border of the ramus has been broken away but it was evidently much more massive than in *Hyainailouros bugtiensis*, a condition obviously correlated with the stouter teeth of the Salt Range specimen.

In M_1 the protoconid is the largest and highest cusp; its summit is pointed but has been somewhat reduced in height by wear on the external side; it has sharp prominent keels anteriorly and posteriorly, the posterior one being practically vertical while the anterior one descends fairly steeply to the notch between the protoconid and the paraconid. Thus not only is the notch lower on the crown than in *Felis* and *Hyæna* and also than in *Hyainailouros sulzeri* but also the blade of the protoconid is farther removed from the horizontal. The outer side of the paraconid is not only worn, but also seems to have been damaged. If this is so, the position of P_4, which is the one in which the collector placed it before handing it over to me, is not the natural one and it lay farther forward. In any case it is impossible to say what was the exact shape or height of the paraconid, nor whether it had a cingular tubercle at the antero-external corner as in the corresponding tooth of *H. bugtiensis*. There is a slight thickening of the posterior base of the crown, of the nature of a faint cingulum, but there is no trace of the small metaconid of *H. sulzeri* or of the more prominent one of *H. bugtiensis.* The absence of this accounts very largely but not entirely for the inferior length of the tooth as compared with *H. bugtiensis.* Both by its more robust build and in the inferior length and diminished shearing character of the paraconid it seems to be nearer to *H. sulzeri* than to *H. bugtiensis.* P_4, as in the corresponding tooth of *H. sulzeri* and *H. bugtiensis*, is composed of three cusps, of which the central one is the stoutest and highest though the wear and damage to the external side of the anterior one does not permit me to determine its exact width; it seems, however, to have possessed more of a shear than the main cusp and in this way to resemble the same cusp in *H. sulzeri.* The posterior cusp has lost a small part of its external edge either by wear or weathering, but it cannot be doubted that it agrees very closely with its assumed homologue in *H. bugtiensis* and *H. sulzeri.* There is the same cutting edge as in *H. bugtiensis* but it is considerably shorter along the antero-posterior axis; internally there is a flat or slightly sloping expanded area, while externally there is a steep descent from the cutting edge to the base of the crown. A striking feature of difference from *H. bugtiensis* and apparently also from *H. sulzeri* is the twisting round of the anterior and posterior cusps of P_4 to the inside of the main cusp, so that the three cusps form a considerable arc, and in consequence the external side of the tooth is strongly convex while the internal side is concave. Some tendency to this is present in both the other species but it is very much less pronounced.

Measurements of species of Hyainailouros.

		H. lahirii.	*H. bugtiensis.*	*H. sulzeri.*
M_1	length	49·7	54·6	49·5
	breadth	32·2	28·1	26·0
P_4	length	35·8	43·7	..
	breadth	24·7	22·9	..
Thickness of ramus below P_4 . .		45·0	app. 32·0	..

Remarks and comparisons.—Reference has been made above (page 169) to Helbing's important conclusion that the large Bugti Carnivore is related not to the Creodont *Pterodon* but to the European species *Hyainailouros sulzeri* Biedermann. Plausible as the suggested affinity appears merely on the evidence of the imperfect Bugti ramus, yet the present find affords yet further support to Helbing's view, if indeed it does not actually place it in the region of certainty. While M_1 of *Hyainailouros sulzeri* marks an advance on *H. bugtiensis* which tends to minimise the superficial likeness to *Pterodon* which first struck the present author in the Bugti species, the new Kamlial species seems to carry on the evolutionary trend to a point where the likeness to *Pterodon* ceases and that to a normal Carnivore more closely akin to the Felidæ becomes pronounced.

From the above descriptions it is evident that the main points of difference of the new species from *H. bugtiensis* are the absence of a metaconid in M_1; and its diminution in size in P_4; the shortening and stoutening of the teeth; and the inward twisting of the anterior and posterior cusps. *H. sulzeri* in respect of the first three characters mentioned seems to occupy an intermediate position between the two Indian species, but to approximate more nearly to the condition found in the Kamlial species. In regard to the last character it resembles the Bugti rather than the Kamlial species.

Sub-family: *MACHÆRODONTINÆ.*

Diagnosis.—Felidæ having teeth for the most part with crenulated crests; incisors progressively enlarging; upper canines progressively increasing in size and lower canines progressively diminishing in size; upper and lower carnassial teeth only slightly notched between the lobes; P^3 frequently with strong anterior cusp; P^4 mostly with reduced protocone with the exception of the most primitive forms; well-developed paracone; with or without a well developed parastyle. The most primitive forms, in which the upper canines are not enlarged have a short muzzle; a long brain case; glenoid fossa not depressed; paroccipital process equal in size to the mastoid process; mandible with normal coronoid process. Concurrently with the increase in length of the upper canines, the muzzle lengthens; the infra-orbital foramen widens; the occipital is heightened; the mastoid process is progressively strengthened; the paroccipital process progressively weakened; the glenoid fossa is depressed; the zygomatic arches become shorter and stouter; the coronoid process of the mandible is progressively reduced; a mental crest or process of the mandible only lacking in the most primitive forms; skeletal structure rather massive; hallux strong.

Measurements of Indian fossil Machærodontinæ and Felinæ.

UPPER DENTITION.

		Sansanosmilus (?) *rhomboidalis* (G. S. I. no. D 154.)	*Sansanosmilus* (?) cf. *rhomboidalis* (G. S. I. no. D 153.)	*Sansanosmilus* (?) cf. *rhomboidalis* (G. S. I. no. D 152.)	*Megantereon* (?) *præcox* (G. S. I. no. D 232.)	*Megantereon* (?) *falconeri* (Br. Mus. no. 39730.)	*Megantereon* (?) *falconeri* (Br. Mus. no. 16850.)	*Sivælurus chinjiensis* (G. S. I. no. D 150.)	*Vishnufelis laticeps* (G. S. I. no. D 266.)	*Sivafelis potens* (?) (G. S. I. no. D 265.)
C.	ant.—post. diam.	12·0	..	..	..	..	..	11·0	12·5	..
	trans. diam.	7·0	..	..	..	..	..	7·8	6·5	..
P^3	ant.—post. diam.	9·0	..	..	..	12·5	..	11·5	app. 11·5	..
	trans. diam.	5·0	..	..	..	6·5	..	6·2	..	..
P^4	ant.—post. diam.	..	21·5	..	31·0	33·0	..	20·6	..	24·0
	trans. diam.	..	..	..	13·5	12·3	..	9·2	..	11·5
M^1	ant.—post. diam.	..	..	..	..	4·5	..	4·6	..	..
	trans. diam.	..	..	..	..	8·0	..	11·2	..	..
Interval between canine and P^3		5·5	..	..	..	15·5	..	4·8	9·0	..
mc.	ant.—post. diam.	..	..	..	..	..	12·0	..	..	..
	trans. diam.	..	..	..	..	..	5·0	..	..	
mm^4	ant. post. diam.	..	..	12·0	..	..	19·0	..	..	..
	trans. diam.	..	..	4·5	..	..	5·5	..	..	..

Measurements of Indian fossil Machaerodontinae and Felinae.

LOWER DENTITION.

		Sansanosmilus serratus (G. S. I. no. D 165).	*Sivasmilus copei* (G. S. I. no. D 151).	*Propontosmilus sivalensis* (G. S. I. no. D 95).	*Paramachaerodus pilgrimi* (G. S. I. no. D 140).	*Paramachaerodus* cf. *pilgrimi* (G. S. I. no. D 167).	*Paramachaerodus indicus* (G. S. I. no. D 141).	*Paramachaerodus indicus* (G. S. I. no. D 251).	*Megantereon* (?) *falconeri* (G. S. I. no. D 100).	*Megantereon* (?) *palaeindicus* (Br. Mus. no. 48436.)	*Sivafelis potens* (G. S. I. no. D 222).	*Sivafelis potens* (Br. Mus. no. 16537*a*).	*Sivafelis brachygnathus* (Br. Mus. no. 16578).	*Panthera cristata* (?) (Br. Mus. no. M 1567).
C	ant.—post. diam.	..	11·0	11·8	13·7	..	12·1	..	..	..	13·0	..	14·0	..
	trans. diam.	..	6·7	8·2	8·3		..	..	..	..	9·5	..	10·0	..
P_2	ant.—post. diam.	..	..	..	..	..	..	..	..	..	..	..	..	..
	trans. diam.	..	..	..	..	..	..	..	..	..	..	..	..	..
P_3	ant.—post. diam.	..	8·2	13·3	14·0	..	13·0	..	8·0	..	12·0	13·0	..	app. 17·5
	trans. diam.	..	4·5	..	7·4	..	..	..	6·3	..	7·0	7·0	..	..
P_4	ant.—post. diam.	15·5	13·8	17·5	18·5	18·0	17·3	..	21·0	23·5	16·5	17·0	19·0	22·5
	trans. diam.	7·0	6·9	..	8·6	8·0	8·3	..	10·5	11·0	8·0	8·5	9·0	12·5
M_1	ant.—post. diam.	app. 19·5	..	21·0	22·5	19·5	19·5	21·0	26·0	..	19·5	18·5	22·5	..
	trans. diam.	8·0	..	8·7	9	9·0	7·7	9·0	13·0	..	9·5	9·5	11·5	..
Depth of ramus beneath M_1		app. 25	32	24·8	27	..	26	..	33·0	..	34·0	32·0	32·0	..
Interval between the canine and P_3		..	18·8	19·1	16·3	..	17·0	..	..	app. 34·5	6·0	..	..	..
Maximum thickness of ramus below M_1.		..	10·7	12·2	12·0	..	11·8	..	17·5	..	app. 15·0	14·5	..	..

Genus : MEGANTEREON, Croizet & Jobert.

1828. *Megantereon*, Croizet and Jobert, Rech. Oss. foss. Puy-de-Dome, p. 201.

Diagnosis.—Machærodontinæ of moderate size; skull very high; with strong sagittal and lambdoidal crests; mastoid process stout; mastoid process and zygomatic process of the squamosal deeply depressed; zygomatic arch short, very robust; very large infra-orbital foramen; muzzle somewhat lengthened; mandible with very deep symphysis and strong mental process; coronoid process weak; none of the molars crenulated; incisors rather small; upper canines long, slender and flattened, with sharp front and hind keels with or without (?) crenulations; lower canines greatly reduced, incisiform, situated at a much higher level than the cheek teeth, not opposed by the upper canines; post-canine diastema rather long; P^2 absent; P^3 and P_3 much reduced; P_3 much smaller than P_4, 2-or (?) 1-rooted, accessory cusps absent or weak; P_4 with moderately well developed anterior and posterior accessory cusps and posterior cingulum; P^4 with cusps pitched considerably backward; with moderate parastyle but with cusp in advance of it absent or rudimentary; protocone rudimentary or absent and only represented by a more or less prominent inner lobe; M_1 with short paraconid and longer protoconid; metaconid absent or vestigial; M^1 small, transverse diameter hardly twice the antero-posterior diameter; limbs short and stoutly built.

Genotype.—*Felis megantereon*, Croizet & Jobert (1827 Pl. i, fig. 1; 1828, pp. 200-201, 205-206, Pl. vii, fig. 3). Though not actually germane to what follows, it may be noted that Matthew (1929, p. 501-503) has clearly shown that the genotype of *Megantereon* is entitled to be designated as *M. megantereon*, Croizet and Jobert and not as *M. cultridens* Cuvier, as some authors think, the latter trivial name being a synonym of *Ursus etruscus*, and only applied to the Mont Perrier Machærodont later than 1827.

Remarks.—The genus *Megantereon* was united by Gervais (1850, p. 126), Gaudry (1863, p. 105), Lydekker (1884, p. 332), Boule (1901, p. 551) and most other authors with *Machairodus* Kaup, under which name all the European Machærodonts were classified for a period of some fifty years. Schaub (1925, p. 215) equally made no generic distinction between the smaller of the two Mont Perrier species of Machærodonts, that is the one designated *Megantereon megantereon* by Croizet and Jobert and the Eppelsheim species *Machairodus aphanistus*, Kaup although he pointed out that the former differed generically by its shorter and stouter limbs and by the non-opposition of the upper and lower canines from the larger Mont Perrier Machærodont, which could not be separated from *Machairodus crenatidens*, Fabrini. Kretzoi (1929, pp. 1308, 1313) considered that these three species were representative of three distinct genera, of which the Eppelsheim form was alone entitled to the name *Machairodus*. In adopting Schaub's views he proposed the name *Epimachairodus* for *M. crenatidens*, Fabrini and definitely revived the genus *Megantereon*. Matthew (1929, pp. 449-507) seems to have been unaware of Schaub's work and equally of Kretzoi's paper, which, though read, had not perhaps been published at that time, but from a study of the dentition arrived at the conclusion that the three European Machærodont species mentioned above were generically distinct the following being the chief differences between *Machairodus* and *Megantereon*:—

1. In *Machairodus* P^3 and P_3 little reduced; in *Megantereon* P^3 and P_3 much reduced.
2. In *Machairodus* upper canine stout; in *Megantereon* upper canine very slender.
3. In *Machairodus* P^4 with small protocone and ectoparastyle well developed; in *Megantereon* with protocone rudimentary or absent, ectoparastyle rudimentary.
4. M^1 in *Machairodus* rather large, transversely extended; in *Megantereon* small, oval to round.
5. Mandible in *Machairodus* without mental process; in *Megantereon* with deep mental process.
6. In *Machairodus* tooth cusps with little backward pitch; in *Megantereon* pitched considerably backward.

He, however, included *M. crenatidens* in the genus *Smilodon*, which according to Schaub is distinguished by its much heavier build and other characters.

I have elsewhere (Pilgrim, 1931, pp. 126-128) summarised the facts in greater detail and diagnoses of *Machairodus* and *Epimachairodus* are repeated on page 194 of the present work. It is unnecessary here to do more than indicate where the evidence for the validity of the genus *Megantereon* may be found.

The non-crenulation of the canines has been taken as characteristic of the species *Megantereon megantereon*, and therefore of the genus, but Matthew (1929, p. 503) has suggested that this may be merely specific or even accidental. I am inclined to think that too much has been made of variations in the degree or position of crenulation on Machærodont canines. While the tendency to crenulation in itself seems to be an important character, which serves to distinguish the Machærodontinæ from the Felinæ, yet variations in it are frequent in species which otherwise resemble one another. Moreover the conditions of preservation so often obscure the crenulation, that one is not justified in generalising on one or two specimens only. Indian species which resemble *Megantereon* so closely as to be placed provisionally in that genus, have the canines crenulated. These are the two species described below under the names of *Megantereon* (*?*) *falconeri* and *Megantereon* (*?*) *palæindicus.*

MEGANTEREON (?) FALCONERI, Pomel.

1846. *Machaerodus,* Owen, Brit. Foss. Mamm. and Birds, pp. 178-179.
1853. *Megantereodon falconeri,* Pomel, Cat. Meth. Vert. Foss., p. 56.
1862. *Machairodus falconeri,* Gaudry, Anim. Foss. Attique, p. 113.
1868. *Drepanodon sivalensis,* Falconer, Pal. Mem. I, p. 550, Pl. xxv, figs. 5, 6.
1880. *Machœrodus sivalensis,* Falconer and Cautley, Bose, *Quart. Journ. Geol. Soc., London,* XXXVI, pp. 122-125, Pl. vi, fig. 5.
1884. *Machaerodus sivalensis,* Falc. and Caut., Lydekker, *Pal. Ind.,* (10), II, p. 334, Pl. xliv, figs. 1, 2, 4, 5, 6.
1929. *Meganthereon falconeri,* Pomel, Matthew, *Bull. Amer. Mus. Nat. Hist.,* LVI, p. 503.
1929. *Drepanodon* (*Telosmilus* n. gen. ?) *cautleyi,* Kretzoi, Proc. Congr. Intern. Zool. 1927 Budapest, p. 1331.

Diagnosis.—A *Megantereon* of somewhat larger size than *M. megantereon*; upper canines crenulated on the posterior keel; P^3 slightly shorter than in *M. megantereon*; P^4 with a rudiment of an accessory cusp anterior to the parastyle, and exceptionally reduced protocone; mandible with mental process starting farther forward and probably more abrupt and deeper than in *M. megantereon*; P_4 with posterior cingulum stronger and more cusp-like.

Lectotype.—Owen (1846, p. 178) described three specimens of an Indian Machærodont, all in the British Museum; two maxillæ, nos. 16350 and 39730 and a mandibular ramus no. 16557, but did not name them specifically. Pomel (1853, p. 56) seems to have based his specific diagnosis on Br. Mus. nos. 16350, 16557, 16554 and probably one or more additional specimens, but definitely indicated none of them as the type. Equally was no type specified either in Falconer, Pal. Mem. I, p. 550, though nos. 16350 and 16557 were there figured (Pl. xxv, figs. 5, 6), nor by Bose (1880, p. 122, Pl. vi, fig. 5). Lydekker (1884, p. 335) selected as holotype the left mandibular ramus containing M_1, P_4 and the broken base of P_3 figured in Falconer, Pal. Mem. I, Pl. xxv, fig. 6, and by Lydekker (1884, Pl. xliv, figs. 4, 4*a*). This is in the British Museum regd. no. 16557.

Referred specimens.—A left mandibular ramus (Br. Mus. no. 16554) containing M_1 and $P_{3\text{-}4}$.

A right mandibular ramus (G. S. I. no. D 100) containing M_1 and $P_{3\text{-}4}$ from the Siwalik Hills near Rurki, figured by Lydekker (1884, Pl. xliv, fig. 5).

Matthew (1929, p. 504) considered that a left mandibular ramus (Br. Mus. no. 48929) containing M_1 and P_4 and referred by Lydekker (1884, p. 329) to *Felis* sp. aff. *pardus,* though slightly smaller than the holotype could not be separated from it.

Lydekker (1884, p. 336, text fig. 18) referred to this species a left mandibula-ramus containing M_1-P_3 and part of the alveolus of the canine from the Siwalik Hills, which is in the Science and Art Museum, Dublin (no. 46).

A left maxilla (Br. Mus. no. 39730) containing M^1, P^4 and the somewhat broken P^3 from the Siwalik Hills, described by Bose (1880, p. 124) and described and figured by Lydekker (1884, p. 338, text fig. 19, Pl. xliv, fig. 2).

A right maxilla of a juvenile individual (Br. Mus. no. 16350) containing the canine and mm^4 from the Siwalik Hills described and figured by Bose (1880, p. 123, Pl. vi, fig. 5) and by Lydekker (1884, p. 338, Pl. xliv, figs. 1, 1*a*).

I rather doubtfully refer to this species the posterior portion of a skull (G. S. I. no. D 63) from the Upper Siwaliks of the Hoshiarpur district, described and figured by Lydekker (1884, p. 339, text fig. 20).

Locality.—The type locality is the Siwalik Hills, nothing more precise having been recorded. With the exception of the doubtfully referred skull, which was collected by Theobald in the Hoshiarpur district, all the referred specimens came from the Siwalik Hills.

Horizon.—Upper Siwalik, probably Pinjor stage, but not definitely known.

Remarks.—The holotype and the referred specimens were fully described by Lydekker (1884, pp. 334-341). He has shown that both the mandibles and the referred maxillæ are closely allied to *Megantereon megantereon*, but he also finds resemblances to *Smilodon neogaeus* and *necator*, which he thinks are of the most importance. Matthew, as I think rightly, emphasises the resemblances to *Megantereon megantereon*: the small double-rooted P^3 and P_3; the rudimentary nature of the anterior accessory cusp in P^4; the only moderate development of the accessory cusps in P_4; the distinct mental process in the mandible; the very short maxilla with large infra-orbital foramen; the reduction of M^1. Lydekker considered that the coronoid process of the Indian species was weaker than in *Megantereon megantereon*, and closer to *Smilodon neogaeus*, but the evidence for this seems very questionable. I see nothing in any of the rami to indicate that the coronoid process was not similar to that of *Megantereon megantereon*, in which it is also weak. On the other hand in *Smilodon* P^3 and P_3 are still more reduced or even absent; the accessory cusps of P^4 and P_4 are very prominent and large; the mental process of the mandible is practically absent; and the upper canine is extremely long and broad. Judging by the milk canine of Br. Mus. no. 16350 the upper canine of the Indian species was much shorter and altogether more slender, and so much more like that of *Megantereon megantereon.* The crenulations on the milk canine of *M. falconeri* are not seen on the permanent canines of *Megantereon megantereon,* but as suggested above (page 175) the absence of these must often be due to an accident of preservation, or in any case deserving of no more than specific recognition.

Kretzoi (1929, p. 1316) classifies this species with a query as *Machairodus,* but the characters in which it agrees with *Megantereon megantereon* differentiate it, equally with the Mont Perrier species, from *Machairodus aphanistus.* It is possibly closer to *Epimachairodus,* but the absence of a mental process and the long broad upper canines in that genus distinguish it from *M. falconeri.*

Kretzoi (1929, p. 1331) considers that the left maxilla (Br. Mus. no. 39730) here referred to this species, cannot belong to the same species or even the same genus as the mandibles, and suggests for it the name *Telosmilus cautleyi.* He remarks: ‘*Machairodus ? falconeri* (Pomel) kann von unserer Art (*i.e. Telosmilus cautleyi*) durch ihre hochkronige, besonders aber massiver Bezahnung im Gegenteil zur schlanken, keinesfalls auf die echten Machairodontiden deutender Bezahnung scharf unterschieden werden’, and his diagnosis is as follows: ‘Foramen infraorbitale mässig weit. P^3 klein, niedrig, ohne (?) Paracon. P^4 mit niedriger Krone, schwachen Parastyl, hochgradig reduzierten Deuterocon’. I have carefully compared Br. Mus. no. 39730 with the type ramus of *Megantereon* (?) *falconeri* (Br. Mus. no. 16557) and also with casts of the associated skull and mandible of *Megantereon megantereon* figured by Gervais (1848-52, Pl. xxvii, figs. 1, 2). The dimensions in millimetres of the teeth in question in these specimens are the following:—

——		*Megantereon (?) falconeri*		*Megantereon megantereon* associated skull and ramus.
		Br. Mus. no. 39730 referred maxilla.	Br. Mus. no. 16557 type ramus.	
P^4	height	18·0	..	16·0
	transverse diam.— in front of protocone	9·5	..	9·0
	do. at protocone	12·5	..	13·5
	ant. post. diam.	33·0	..	29·5
M_1	height	..	app. 17·5	12·0
	transverse diam.	..	11·0	10·0
	ant. post. diam.	..	24·5	20·0

These measurements do not bear out Kretzoi's views. It is seen that both the ramus and the maxilla of *M.* (?) *falconeri* belong to a larger form than *M. megantereon,* and that the type ramus of *M.* (?) *falconeri* is too large to have belonged to the same individual as the referred maxilla. Allowing, however, for the latter difference it is evident that the relative dimensions of P^4 and M_1 in the Indian specimens are much the same as they are in the single individual of *Megantereon megantereon.* Of the characters mentioned in Kretzoi's diagnosis the only ones in which the maxilla (Br. Mus. no. 39730) does not agree with the species *Megantereon megantereon* are the smaller P^3 and the more reduced protocone in P^4. In addition the anterior accessory cusp (ectoparastyle) in P^4 is more pronounced. Corresponding to these in the ramus (Br. Mus. no. 16557) P_3 is also smaller than in *M. megantereon* and the posterior cingular cusp of P_4 is stronger. These may be of generic importance but on the fragmentary Indian material it does not seem advisable to regard them as of more than specific value, while in any case the specific separation of the adult and the juvenile maxillæ from the rami seems to be quite unjustifiable.

MEGANTEREON (?) PALAEINDICUS (Bose).

1868. *Drepanodon sivalensis,* Falconer and Cautley, *pars.*, Falconer Pal. Mem. I, p. 550.

1880. *Machœrodus palæindicus,* Bose, *pars.*, *Quart. Journ. Geol. Soc. London,* XXXVI, p. 125, Pl. vi, figs. 1-3.

1884. *Machœrodus palæindicus,* Bose, *pars.*, Lydekker, *Pal., Ind.*, (10), II, p. 341, Pl. xlv, fig. 3.

Diagnosis.—A *Megantereon* of larger size than *M. falconeri* ; mandible more robust ; with a deeper symphysis ; mental process beginning to descend farther to the rear than in *M. falconeri* ; P_4 stouter, with a relatively large posterior accessory cusp ; P_3 one-rooted ; with a relatively much shorter post-canine diastema than in *M. megantereon.*

Holotype.—The left mandibular ramus containing the alveoli of the canine and P_3 and the crown of P_4 described and figured by Bose (1880, p. 125, Pl. vi, figs. 1-3) and by Lydekker (1884, p. 341, Pl. xliv, fig. 3). This is in the British Museum regd. no. 48436.

Referred specimens.—The occipital portion of a skull (Br. Mus. no. 39728) from the Siwalik Hills figured in unpublished plate N, figs. 1, 1*a-c* of the Fauna Antiqua Sivalensis under the name of *Drepanodon sivalensis* (Falconer, Pal. Mem. I, p. 550) and described by Bose (1880, p. 126) and by Lydekker (1884, p. 343) as *Machœrodus palaeindicus.*

A much damaged skull (Br. Mus. no. 39729) from the Siwalik Hills figured in unpublished plate N, fig. 2 of the Fauna Antiqua Sivalensis under the name of *Drepanodon sivalensis* (Falconer Pal. Mem. I, p. 550) and described by Bose (1880, p. 126).

Locality.—The Siwalik Hills.

Horizon.—Upper Siwalik, stage uncertain but probably Pinjor.

Remarks.—Lydekker has fully described the holotype, which seems by the presence of a mental process and by the reduction of P_3 to be allied to *Megantereon falconeri* and *M. megantereon.* It is larger than both the species named and P_3 is even more reduced, being one-rooted. The symphysis and the mentae process are also deeper, and the latter begins to descend farther back, immediately in front of P_4. P_4 is also stouter and has a relatively large posterior accessory cusp. The post-canine diastema is much shorter than in *M. megantereon,* indicating a weaker upper canine."

Bose (1880, p. 125, Pl. vi, fig. 4) referred to the species a right ramus with P_3 and P_4 from the Siwalik Hills (Br. Mus. no. 48437) and Lydekker (1884, p. 341, Pl. xliii, fig. 8) another right ramus from the Siwalik Hills (Br. Mus. no. M 1567). Neither of these specimens has any trace of a mental process. Lydekker attributed this to the fact of their belonging to females. Matthew (1929, p. 505) points out that no such difference exists between the sexes in the Felidæ, and also calls attention to other important differences: P_3, certainly in M 1567 and possibly in 48437, is double-rooted; the masseteric fossa is relatively deep and abrupt as in the Felinæ instead of shallow and with gently sloping margin as in the Machærodontinæ; the cingulum of P_3 is broader than in the holotype. He regards both as Felinæ, differing specifically from one another, one of them being probably the mandible of *Felis cristata.*

MEGANTEREON (?) PRAECOX, sp. nov.

(Pl. IX, fig. 2.)

Diagnosis.—A *Meganteron* of slightly smaller size than *M. falconeri*; P^4 with a somewhat more prominent protocone; a stronger accessory cusp in advance of the parastyle; a larger and more posteriorly situated M^1.

Holotype.—The left maxilla containing P^4 and the alveolus of M^1 figured in Pl. ix, figs. 2, 2*a* of the present work. It is in the collection of the Geological Survey of India in Calcutta regd. no. D 232.

Locality.—Haritalyangar, Belaspur State, Simla Hills.

Horizon.—The Nagri stage of the Middle Siwaliks.

Description.—The holotype is a fragment of the left maxilla broken off along the suture with the zygomatic process, and therefore showing no portion of the lower border of the orbit. The hinder border of the maxilla is extremely stout and rounded, as in the Machærodontinæ in general, and very different from any of the Felinæ. The lower surface of the extremely large infra-orbital foramen is well exposed, commencing about 15 mm. above the base of P^3. Its antero-external margin is exceedingly oblique, and so very different from the vertical direction which it takes in most of the Felidæ. Everything both above and in front of this is missing. P^4 is in a rather advanced stage of wear, the shear being considerably worn on its inner surface. The summits of the paracone and parastyle are broken off. The paracone is higher but shorter than the metacone, both blades being comparatively slender. The parastyle is half the length of the metacone and was probably a moderately high and prominent cusp. There is a distinct, though small accessory cusp in advance of the parastyle, of which the summit is also worn. The protocone is not represented by a definite cusp, but there is a well developed inner lobe mounted on a separate root and lying in advance of the paracone, about midway between the paracone and the parastyle. An angular ridge runs backward from the end of the protocone towards the summit of the paracone. A faint cingulum exists on the outer side of the paracone and metacone and there are the remains of a similar one to be seen here and there on the inner margin. The alveolus of M^1 is broken away obliquely on the inner side, so that its precise outline is not clearly visible, but by prolonging the inner end vertically downward in imagination it can be inferred that its crown was small and oval, the antero-posterior diameter being approximately rather more than half the transverse diameter. There is a very deep cavity in the palate immediately in front of M^1. The hinder portion of what appears to have been a rather large alveolus is seen in front of P^4, which seems to indicate that P^3 was a rather robust tooth. The dimensions of the specimen are given in the table on page 172.

Remarks and comparisons.—Fragmentary as are the remains of this species, yet its great similarity to the corresponding parts of *Megantereon* (?) *falconeri*, leaves no doubt that the two species are closely allied. *M. falconeri* seems to be somewhat intermediate in structure between *M. megantereon* and the present species. *M. praecox* agrees with both the others in respect to the slenderness and general structure of P^4; the rudimentary nature of the anterior accessory cusp (absent in *M. megantereon*) ; the small size of M^1 ; and the extremely large infra-orbital foramen. It is slightly smaller absolutely than *M. falconeri* and there are certain differences of structure which seem to be indicative of a more primitive stage of development. These are: the slightly more widely extended protocone of P^4; the slightly more prominent anterior accessory cusp; the slightly more robust M^1, which is also situated somewhat to the rear of P^4, the maxilla being correspondingly extended further back. Finally the size of the hinder alveolus of P^3 leads to the conclusion that P^3 was rather more stoutly built, possibly longer than in *M. falconeri.* Other differences would doubtless appear if the material were ampler, but those named seem to be quite sufficient to differentiate the present species from *M. megantereon*, more expecially as its horizon is so much earlier than that of the Upper Siwalik species. It is interesting as affording a possible transitional stage between the genera *Sansanosmilus* (page 181) and *Megantereon.* It cannot even be regarded as impossible that this species might be more appropriately placed in *Sansanosmilus*, its preservation being too poor to show serrations on the teeth if such were present.

Genus : SANSANOSMILUS, Kretzoi.

1929. *Sansanosmilus*, Kretzoi, Proc. 10th Intern. Congr. Zool. Budapest 1927, p. 1307.

Diagnosis.—Machærodontinæ of rather small size; mandible with deep mental process; post-canine diastema relatively short; cheek teeth with rather blunt but high cusps; P_3 small, two-rooted, with anterior and posterior accessory cusps; P_4 with high and rather large anterior and posterior accessory cusps and a rather high posterior cingular cusp; (on the assumption that the skull attributed by Filhol to *Machœrodus palmidens* really belongs to that species) upper canines relatively short and slender, with crenulations.

Genotype.—*Felis palmidens*, Blainville (1842, Ostéographie Carnass., II, pp. 157-60, Pl. xvi (Felis)).

Remarks.—Kretzoi (1929, p. 1307) does not consider that the skull described by Blainville under the name of *Felis quadridentata* and referred by Filhol (1891, pp. 47-73), together with a second skull, to *Machœrodus palmidens*, is related to the holotype mandible of *Felis palmidens*; in fact he denies that the two skulls are Machærodont at all, though they have been accepted as such by Boule (1901, p. 568) and other authors. I am not altogether convinced by Kretzoi's arguments against the Machærodontine character of the skull or its association with the mandible. It seems to me that a deep mental process is not necessarily correlated with an exceptionally long or powerful upper canine. For example *Megantereon megantereon*, which has a well developed mental process, has shorter, more slender upper canines than either *Machairodus aphanistus* or *Epimachairodus crenatidens*, in neither of which is a mental process present. On the other hand the upper canine of the skull attributed by Filhol and Boule to *Machairodus palmidens*, though undoubtedly smaller than most other Machærodonts, seems to be too big for one of the Felinæ, against which its crenulated keels also militate strongly. I find it equally difficult to believe that a mandible with such a relatively short post-canine diastema as that of *Felis palmidens* could possess as large an upper canine as Kretzoi thinks is obligatory. The less pronounced Machærodont character of the basicranium of the skull figured by Filhol falls into line with the shorter and weaker upper canines.

The generic differentiation of *Felis palmidens*, however, seems abundantly justifiable. Whether the species *Sansanosmilus palmidens* is on the direct ancestry of *Megantereon megantereon* is probably more open to doubt. In many ways the Middle Miocene genus seems to have a greater affinity to the Indian species *M. prœcox*, *M. falconeri* and *M. palaeindicus*, though a stil lmore probable ancestor for these is no doubt to be found in the Chinji species *serratus* which I here classify as a *Sansanosmilus*. The meagre material of all four of the Indian forms does not admit of more than a tentative reference to the European genera, and it may well be that a more complete acquaintance with their structure would show that they are not congeneric with them.

SANSANOSMILUS (?) SERRATUS, sp. nov.

(Pl. VIII, fig. 9.)

Diagnosis.—A *Sansanosmilus* of about the same size as *S. palmidens*; with higher crowned teeth, having finely crenulated, somewhat more compressed cusps; M_1 with vestigial metaconid; P_4 with internal edge slightly concave on account of the somewhat internal position of the anterior accessory cusp and the posterior cingular cusp.

Holotype.—The fragmentary left mandibular ramus figured in Pl. viii, figs. 9, 9*a-c* of the present work. It is in the collection of the Geological Survey of India, in Calcutta, regd. no. D 165.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The holotype is a fragment of the left mandibular ramus showing M_1 and P_4, both in an early stage of wear, but considerably damaged. M_1 lacks the paracone, and of P_4 only the posterior accessory cusp is perfect, the summits of the other three cusps being broken off. The hinder part of the ramus is missing immediately behind M_1, and only the posterior portion of the hinder alveolus of P_3 is visible, the ramus having been entirely broken away in advance of this. A considerable amount can, however, be inferred both as to the structure of the symphysis and of the individual teeth. The inner surface of the ramus is distinctly concave and the outer surface convex, in an antero-posterior direction. The presence of a sharp ridge on the external surface of the lower border of the ramus, which begins to be apparent opposite the middle of P_4 and descends towards the rear, leaves little doubt, on the analogy of other Machærodont rami, that there was a deep descending mental process, much more pronounced than in *Megantereon falconeri* or *palaeindicus*, in which the downward curve of the ramus does not begin posterior to P_3. It was probably as strong as in *Sansanosmilus palmidens.* This sharp descending ridge is not visible in Pl. viii, fig. 9, which is a view from the inner side, but is very evident in the external view.

The protoconid of M_1 is rather compressed; its blade was evidently distinctly longer than that of the paraconid, and rises into a distinct sharp peak at the rear, from which the profile descends vertically to the base so that the cusp pitches very markedly backward. A very distinct vestige of a metaconid exists behind and closely attached to the protoconid. Both it and the hinder edge of the protoconid show a series of fine crenulations, and these would doubtless have been equally visible on the upper edge of the tooth if it had been unworn. The antero-posterior diameters of the four cusps of which the crown of P_4 consists are as follows from front to rear: 5·5 mm.; 6·0 mm.; 4·5 mm.; 2·5 mm. The only one which is perfect is the posterior accessory cusp. This is almost unworn and still shows some fine crenulations near the summit. It is extremely high, 9·5 mm. above the base of the crown, and is very compressed, pitching towards the rear, with parallel anterior and posterior edges which only approach to form the summit quite near their top. The extreme hinder cusp, which may be called the cingular cusp, lies behind and somewhat internal to the posterior accessory cusp. Its summit is missing but was evidently high, and distinct from the cusp in front of it though close to it. It is extended transversely, so that its breadth exceeds its length, and an additional low cingular ledge, which also shows traces of crenulation, runs inwards and forwards from its base, which causes the postero-internal corner of the tooth to project inward beyond the middle. The main cusp was evidently very high and much stouter than the posterior cusp. The anterior accessory cusp was only slightly inferior in length to the main cusp, but was more conical, its base as seen in cross section being circular. This is due to its greater extension on the inner side. The inward position of the anterior accessory cusp and of the posterior cingular cusp causes the inner outline of the tooth to be concave and the outer outline convex. The measurements not given above are in the table on p. 173.

Remarks and comparisons.—The Machærodont nature of the holotype is evidenced by the crenulated teeth and the existence of a mental process. Of the known Machærodonts, the only ones with which I can compare it are *Megantereon* *falconeri* and *Sansanosmilus palmidens.* It is of considerably smaller size, but its structure seems to be analogous to that of *Megantereon falconeri.* In both cases there is a strong mental process; the cusps pitch backward; there is a vestigial metaconid in M_1; the protoconid in M_1 considerably exceeds the paraconid in length and both in number and position the cusps in P_4 are similar. The teeth, however, are more compressed; higher crowned; P_4 has much higher and more isolated cusps, in particular the anterior accessory cusp is stouter, and the posterior accessory cusp is higher, longer and more compressed, while the cingular cusp is stouter and higher; the mental process is probably deeper. There are no crenulations visible on the cheek teeth in *Megantereon falconeri*, but their absence may be only accidental. Except for the apparent absence of crenulations on the cheek teeth, the differences mentioned seem to be just those which distinguish *Sansanosmilus palmidens* from *Megantereon.* From Filhol's (1891, p. 66) description of the mandible of *Sansanosmilus palmidens*, the cusps of that species seem to be lower and somewhat less compressed than in the Indian species and a vestigial metaconid in M_1 is not mentioned.

The existence of a maxilla in the Chinji beds, (G. S. I. no. D 154) described below under the name of *Sansanosmilus*(?) *rhomboidalis*, in which the canine is very slender and crenulated, but at the same time very short, suggests that Machærodonts of this kind lived at that period in India as in Europe and perhaps strengthens the case for the attribution of the present species to *Sansanosmilus.* In any case, even should the affinity between this species and *Sansanosmilus palmidens* prove to be less close than I suspect, yet it may with greater safety be accepted that it represents a primitive stage of the Nagri *Megantereon* (?) *praecox* and the Upper Siwalik M. (?) *falconeri* and *palaeindicus* just as the ancestral relationship between *Sansanosmilus palmidens* and *Megantereon megantereon* seems to have much in its favour.

SANSANOSMILUS (?) RHOMBOIDALIS, sp. nov.

(Pl. VIII, figs. 5, 10, 11.)

Diagnosis.—A primitive Machærodont of smaller size than *Sansanosmilus palmidens* with a very short slender upper canine, having the root much longer than the crown, of an elongate rhomboidal cross-section, with crenulated edges, with hinder keel straight and not curved; P^4 probably slender; infra-orbital foramen high and narrow.

Holotype.—The left maxilla containing the canine and the base of the crown of P^3, figured in Pl. viii, figs. 10, 10*a.* It is in the collection of the Geological Survey of India in Calcutta regd. no. D 154.

Referred specimens.—A left mm^3 from Chinji (G. S. I. no. D 152) figured in Pl. viii, figs. 11, 11*a* of the present work. A left P^4 from Chinji (G. S. I. no. D 153) figured in Pl. viii, figs. 5, 5*a*, 5*b* of the present work.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The measurements of the holotype and referred teeth are included in the table on p. 172. The holotype consists of the front part of the left maxilla lacking the portion above and behind the anterior surface of the infra-orbital foramen and showing the canine, which has lost the extreme tip, the broken crown of P^3, and part of the alveolus of the front root of P^4. It is exceedingly slender in proportion to its height; its anterior border slopes backward at an angle of about 30°. The premaxillary suture is about seven mm. in advance of the anterior edge of the canine and this part of the maxilla shows only a slight tendency to bend round towards the inside. The infra-orbital foramen is approximately vertical, very high in proportion to its transverse dimension and opens into a slight hollow in front. It is hardly likely that the root of the jugal process of the zygomatic arch projected much, or that it overhung the teeth to any great extent. The canine is extraordinarily slender. Its crown could not have been more than 40 mm. in length, since only about seven mm. are broken off from the tip. There are two keels, which lie almost exactly opposite one another in a fore and aft direction. The posterior keel is extremely sharp; the anterior keel is blunter. Neither the inner nor the outer surface which lie between the keels is regularly convex, but in each case a distinct angle is formed, which is situated nearer to the anterior than to the posterior keel, this angle being slightly more prominent on the outer side. In consequence of this the cross-section at the base is of a narrow, diamond shape. The profile of the posterior keel is so slightly curved that it may be regarded as vertical; the anterior keel is somewhat curved. The whole tooth shows a series of fine striæ from which it may be concluded that the keels were crenulated in some degree, though they are too greatly worn to preserve any actual trace of the crenulations. The upper fractured edge of the specimen shows the cross-section of the root, which is quite as long as its cross-section at the base of the crown, so that the total length of the root must have vastly exceeded that of the crown. Between the canine and P^3 there is a rather long diastema of 5·5 mm. which shows no trace of any alveolus, so that P^2 must have been absent. P^3 is known only by its roots, which are two in number and of approximately equal size. The estimated length of the crown is nine mm. Immediately beneath the infra-orbital foramen the antero-external root of P^4 is preserved. This is small and slender. I can find no trace of an internal root so that if present it must have lain at some little distance behind the antero-external root.

The referred mm^3 (G. S. I. no. D 152) seems to be Machærodont, judging by the absence of an inner cusp and lobe, and it was relatively slender. The three cusps of which it consists are the paracone, which is not separated from the metacone by any distinct notch, is but little higher than and slightly shorter than the metacone. The latter is a high trenchant blade which shows a faint trace of crenulation. The parastyle is as high as the metacone and is almost as long as the paracone. The three cusps are almost in the same straight line, and on the inner side of each of them a prominent cingulum is developed.

The referred P^4 (G. S. I. no. D 153) is obviously the upper carnassial tooth of a Machærodont, since not only does it show a faint trace of former crenulation on the anterior edge of the paracone, but the protococone must have been extremely reduced. It is true that the antero-internal corner of the crown is broken off at the base, but since the cross section of the root is hardly at all expanded laterally, a protocone must have been almost non-existent. This character united to its slenderness decidedly suggests an affinity to both *Megantereon* (?) *falconeri* and *praecox* and to *Sansanosmilus* (?) *serratus*, but in particular to the holotype maxilla of the present species. All the cusps are considerably facetted by wear. The paracone is pointed, and much higher than the metacone, though greatly inferior to it in length. In spite of the wear a distinct angular ridge can be seen running backward from its summit to the base of the crown, at the spot where the rudimentary protocone would have stood. The metacone is a long low shearing blade. A parastyle is plainly developed but it is not as much as half the length of the paracone. In front of the parastyle there seems to have been a cingulum, though the fracture of the base prevents much of it from being seen. There are remains of cingula on the antero-external half of the tooth and also internally. The enamel is seen to be distinctly rugose, wherever its original surface is preserved.

Comparisons.—There is so little of the holotype preserved that it is hardly possible to refer it to any definite genus, but I have considered it better to name it specifically and to refer it provisionally to *Sansanosmilus*, as I have found no parallel to it in any previously described species. I can hardly doubt that it is Machærodontine, not only because of the slender upper canine but also because of the assumed presence of crenulations on the keels, the reduced P^3 and the posteriorly situated and probably reduced inner root of P^4. The length of the upper canine is less than in any Pontian Machærodontine species, but is relatively but little shorter than that of the skull referred by Filhol to *Machaerodus palmidens* (= *Sansanosmilus palmidens*). The upper canine is very much less slender in that skull and has a more oval cross section, which is not at all diamond-shaped. Moreover the root is very much shorter than in the Chinji species. The latter is obviously a very primitive form, in which the upper and lower canines were of more nearly equal length than in later developmental stages. Having regard to the exceedingly slender canines of *Megantereon* (?) *falconeri*, it does not seem at all improbable that it may be an ancestral form of that species.

I have mentioned above (p. 183) the likelihood that the *Sansanosmilus* to *Megantereon* line in Europe may be parallel to that of *Sansanosmilus* (?) *serratus* to *Megantereon* (?) *praecox* and *falconeri* in India, and it is possible that the maxilla before me may belong to the holotype ramus of *Sansanosmilus* (?) *serratus*. There does not seem to be much discrepancy in size, and the cheek teeth of the Chinji ramus are characterised by extreme slenderness. If Kretzoi's opinion that the skull from Sansan referred by Filhol to *Sansanosmilus palmidens* does not belong to it is correct, then, since in that case the skull of the Sansan species is unknown, there is no evidence that the species *Sansanosmilus*(?) *serratus* is not congeneric with the Sansan species, and both of them may have possessed a similar type of skull and upper canine to that of the form now under consideration. There is no other mandible from Chinji with which this maxilla can be associated

The lower canine of *Sivasmilus copei* is far too stout and too large to have anything to do with such a slender upper canine as this.

The isolated mm^3 (G. S. I. no. D 152) is sufficiently close to the corresponding tooth in the juvenile maxilla (Br. Mus. no. 16350) from the Upper Siwaliks referred to *Megantereon* (?) *falconeri* to be suggestive of some affinity between them. In neither is there any trace of an inner cusp or lobe. The parastyle is much stronger and higher in the Chinji specimen and the metacone is higher but less long relatively to the paracone. The pronounced inner cingulum of the Chinji mm^3 is not evident in the Upper Siwalik tooth. Its absence may be partly due to its poor state of preservation, but it is probable that in any case it was much less developed.

The isolated P^4 (G. S. I. no. D 153) seems to be related to the mm^3, by its rudimentary protocone, and its slenderness; and both are of a size that would not prohibit their belonging to the same species as the holotype maxilla of *Sansanosmilus* (?) *rhomboidalis.* As remarked above the resemblance to the mature and juvenile maxillæ referred to *Megantereon* (?) *falconeri* and to that of *Megantereon* (?) *praecox* is probably significant and suggests that this may be an ancestral form of the Nagri as well as the Pinjor species.

Genus: PARAMACHÆRODUS, Pilgrim.

1913. *Paramachaerodus,* Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, p. 291.
1929. *Pontosmilus,* Kretzoi, 10th Internat. Congr. Zool. Budapest, p. 1298.
1929. *Protamphimachairodus,* Kretzoi, 10th Internat. Congr. Zool. 1927, p. 1316.

Diagnosis.—Machærodontinæ of medium size; with short muzzle; infra-orbital foramen narrow; zygomatic arch somewhat shortened; upper canine rather weak, relatively rather short; lower canine rather stout; mandible with shallow symphysis; canines and incisors not elevated above the level of the back teeth; without mental process but with more or less prominent mental crest; post-canine diastema short; strong coronoid process; incisors small, variable, without crenulated crests; P^3 and P_3 with anterior cusps practically absent, much simpler in structure than P^4 and P_4; P^4 with low metacone, well developed parastyle, small ectoparastyle and strong protocone; P_4 with accessory cusps only moderately developed; M^1 much reduced; M_1 long, with vestigial metaconid; skeletal structure slender, with long limbs.

Genotype.—*Machairodus orientalis,* Kittl (1887, p. 329).

Species.—*Machairodus orientalis,* Kittl (=*M. schlosseri,* Weithofer, *M. hungaricus,* Kormos); *Felis ogygia,* Kaup; *M. maximiliani,* Zdansky; *P. indicus* (Kretzoi); *P. pilgrimi,* Kretzoi.

Remarks.—I have discussed elsewhere (Pilgrim, 1931, pp. 135, 136) the validity of the genus *Paramachaerodus,* and also the claim of *Machairodus orientalis* Kittl to be regarded as the genotype. No more than a brief summary of these questions is therefore needed.

Kretzoi's (1929, p. 1300) choice of the species *Paramachaerodus pilgrimi* Kretzoi as the genotype of *Paramachaerodus* is unjustified, since that species did not exist by name at the time when the genus was established. Any one of the European species *M. orientalis*, *M. schlosseri* or *M. hungaricus* might have been accepted as the genotype, but since I regarded the two last named as synonyms of the first, I omitted to state definitely that *M. orientalis* was the genotype, although my intention must have been obvious. It was understood by Matthew (1929, p. 506), who specifically refers to *M. schlosseri* as the genotype. It is easy to see the reason for Kretzoi's hesitation, since he separates *Paramachaerodus pilgrimi* generically from *Paramachaerodus orientalis* and *P. schlosseri.* Were I to accept this view I should be disposed to allow Kretzoi's assignation of genotypes to stand, in order to avoid confusion, but since I cannot see any reason for making a new genus on the material available, I think that it is better to adhere to my original intention and choose as genotype a species which is not only represented by more perfect material but is also more readily accessible, being in European museums, in preference to the poorly preserved *Paramachaerodus pilgrimi*, which, being in Calcutta, is much more difficult of access.

While Matthew (1929, p. 501) has advocated the merging of *Paramachaerodus* Pilgrim into *Machairodus* Kaup, Kretzoi (1929, p. 1300) considers that *P. pilgrimi* should be generically separated from the other species which are here included in *Paramachaerodus*. Arguments against these two extreme views are advanced elsewhere (Pilgrim, 1931, p. 136). The shallow symphysis; the position of the lower canines and incisors on the same level as the back teeth; the relatively short post-canine diastema; the relatively short upper canines; the simpler P^3 and P_3; the strong protocone in P^4; and the slender limbs militate strongly against Matthew's view. On the other hand all the species which I refer to *Paramachaerodus* equally share most of the above mentioned characters. The characters on which Kretzoi relies for putting *P. pilgrimi* into a distinct genus are possessed by one or other of the remaining species. These differences are mentioned below (pages 188, 189), and I cannot in the circumstances regard them as of more than specific importance, especially in view of the poor state of preservation of the holotype of *P. pilgrimi.*

The long slender limbs of this genus combined with the opposition of the upper and lower canines, the crenulated teeth, and the absence of a mental process seem to ally it with *Epimachairodus* rather than with *Machairodus*, *Megantereon*, or *Smilodon.* It differs from *Epimachairodus* by the short post-canine diastema, the relatively short upper canines, and the less reduced P^3 and P_3. These point to its being in a more primitive stage of development than *Epimachairodus*, and it does not seem unlikely that the Pontian species of *Paramachaerodus* are relics of a Machærodont type, which was ancestral to *Epimachairodus* and *Paramachaerodus* alike. *E.* ? *taracliensis* (Riabenin) (*see* Pilgrim 1931, p. 132) is in some ways intermediate between the two genera. It has attained almost as great absolute dimensions as *Epimachairodus crenatidens* but has a less reduced P_3 than that species. On the other hand the post-canine diastema is longer and the upper canine larger than in *Paramachaerodus.*

Another somewhat intermediate type between the two genera is perhaps to be found in *Propontosmilus sivalensis* (Lydekker) (*see* page 191), which agrees with *Paramachaerodus* in its small size and unreduced P_3, but has the stout shallow ramus and the long post-canine diastema of *Epimachairodus ? taracliensis.* The retention of a rudimentary P_2 in this species is a relic of a still more primitive stage. The origin of this branch does not appear to have been in Europe, and so far the Chinji and Kamlial stages of India have yielded no definitely ancestral forms, though *Sivasmilus copei*, Kretzoi possesses some features which might qualify it for such a position.

PARAMACHÆRODUS PILGRIMI, Kretzoi.

(Pl. VIII, fig. 6.)

1913. *Paramachaerodus* sp., Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, p. 291.

1915. *Paramachaerodus* cf. *schlosseri*, Pilgrim, *Op. cit.*, XLV, p. 139, Pl. v, figs. 1, 1*a*.

1929. *Paramachaerodus pilgrimi*, Kretzoi, Proc. Intern. Congr. Zool. 1927, Budapest, p. 1300.

1929. *Machaerodus sivalensis*, Lydekker, *pars*, Matthew, *Bull. Amer. Mus. Nat. Hist.*, LVI, p. 506.

Diagnosis.—A *Paramachaerodus* of about the same size as *P. orientalis*; with mental process slightly less pronounced than in *P. orientalis*; the foremost of the two mental foramina larger; the post-canine diastema shorter; ramus slightly deeper and stouter; P_3 more pointed anteriorly; angle between the front and lower border of the symphysis more nearly a right angle, 105° instead of 115°; with crenulated teeth.

Holotype.—The left mandibular ramus described and figured by Pilgrim (1915, p. 139, Pl. v, figs. 1, 1*a*) under the name of *Paramachaerodus* cf. *schlosseri* Weithofer. It is in the collection of the Geological Survey of India in Calcutta regd. no. D 140.

Referred specimen.—A right mandibular ramus (G. S. I. no. D 167) from Kotal Kund, Salt Range, containing M_1 and P_4 is doubtfully placed here. It is figured in Pl. viii, figs. 6, 6*a*.

Locality.—Hasnot, Kotal Kund, Salt Range.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks.

Remarks.—The holotype has been already described and figured (Pilgrim, 1915, p. 139, Pl. v, figs. 1, 1*a*). As previously remarked (Pilgrim, 1915, p. 141) P_3 shows distinct traces of crenulations on the anterior edge of the main cusp, but whether such crenulations would also be visible under favourable conditions in *P. orientalis*, can only be conjectured. The damage which the hinder end of M_1 in the holotype has sustained does not allow one to say that a heel was present as in *P. indicus.* The referred ramus (G. S. I. no. D 167) shows no trace of such a heel, and M_1 is slightly smaller than in the holotype. This may represent a third Indian species intermediate between *P. pilgrimi* and *P. indicus.* In spite of its damaged condition, I think that both Kretzoi and Matthew are right in separating it specifically from the ramus figured by Weithofer (1888, p. 233, Pl. xi figs. 3-7) as *Machairodus schlosseri.* The differences are stated in the diagnosis above. It agrees with *P. ogygia* in the more pointed lower premolars, the weaker mental crest and the more vertical chin; with

P. hungaricus in regard to the stouter and deeper ramus and the smaller posterior mental foramen; and with *P. indicus* by the shorter post-canine diastema. I have elsewhere commented on the variation which seems to exist in the species *P. schlosseri* from Pikermi, as shown by the three mandibles of that species which are recorded (Pilgrim, 1915, pp. 140, 154; 1931, p. 139), which renders it most unlikely that the characters quoted by Kretzoi as evidence of the generic distinctness of *P. pilgrimi* are of more than specific value.

Matthew's (1929, p. 506) proposal to unite this species specifically with *Pseudaelurus sivalensis* Lydekker under the generic name of *Machaerodus* is perhaps only suggested as a provisional measure on account of the obviously imperfect condition of both the holotypes. In any case the holotype of *Pseudaelurus sivalensis* Lydekker differs so greatly from the present species by its longer post-canine diastema, the shallower and stouter ramus, and the presence of P_2, that the specific union of the two cannot be seriously entertained. Seeing that Kretzoi has named all these specifically, we may not, I think, be any longer deterred by unwillingness to burden the nomenclature with names for ill-defined species.

PARAMACHÆRODUS INDICUS (Kretzoi).

(Pl. VIII, fig. 7.)

1913. *Paramachaerodus* sp., Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, p. 291.

1915. *Paramachaerodus* cf. *schlosseri* (Weithofer), Pilgrim, *Op. cit.*, XLV, p. 139, Pl. v, figs. 2, 2*a*.

1929. *Pontosmilus indicus,* Kretzoi, Proc. Intern. Congr. Zool. 1927, Budapest, p. 1300.

1929. *Pseudaelurus* (*Metailurus*) sp., Matthew, *Bull. Amer. Mus. Nat. Hist.*, LVI, p. 506.

Diagnosis.—A *Paramachaerodus* of approximately the same size as *P. pilgrimi*; ramus rather shallower and more slender in every part; with two mental foramina of which the posterior one is stronger than in *P. pilgrimi*; M_1 relatively shorter with a distinct small heel, crenulations present on the hinder edge; upper canine crenulated on both keels.

Holotype.—The left mandibular ramus containing M_1, P_4 and the alveoli of the canine and P_3, described and figured by Pilgrim (1915, p. 139, Pl. v, figs. 2, 2*a*) under the name of *Paramachaerodus* cf. *schlosseri* Weithofer. It is in the collection of the Geological Survey of India in Calcutta regd. no. D 141.

Referred specimens.—An isolated M_1 from Bahitta (G. S. I. no. D 251).

An upper canine (G. S. I. no. D 261) lacking the greater part of the crown from Hasnot, figured in Pl. viii, figs. 7, 7*a*.

Locality.—The type locality is Bahitta, south of Hasnot, Salt Range. Referred specimens were collected both at Bahitta and Hasnot.

Horizon.—The Dhok Pathan stage of the Middle Siwaliks, possibly extending rather lower in the sequence than the typical level for Dhok Pathan fossils.

Remarks.—The holotype has been already described and figured (Pilgrim 1915, p. 139, Pl. v, figs. 2, 2*a*). Although it was there mentioned that the chin was defective, the appearance of the figure led Matthew (1929, p. 506) to suggest that it belonged to a 'true cat', and to classify it as *Pseudaelurus* (*Metaïlurus*). Actually the beginning of the Machærodont mental crest is shown on the lower surface of the ramus and, except by being slightly more slender and possibly with a less pronounced mental crest than in *P. pilgrimi*, there does not seem to be any essential difference between the chin of the two species. The ramus has been weathered to an extraordinary degree, exposing the roots for a considerable distance below the bases of the tooth crowns, so that in spite of the appearance in the figure, the depth of the ramus was but little less than in *P. pilgrimi*, nor was the canine situated at a much, possibly not at all higher level than the cheek teeth. The posterior of the two mental foramina is certainly larger than in *P. pilgrimi*, but how far this is of specific value I feel doubtful. M_1 is relatively shorter than in *P. pilgrimi*, and has a small but very distinct heel, the existence of which in *P. pilgrimi* the damaged condition of M_1 in that species does not permit me to predicate. G. S. I. no. D 167 (see page 188) certainly has no such heel, but its reference to *P. pilgrimi* is only provisional. It was on account of these imperfections in the holotypes of the two species added to the variations in the European species that I did not think that it was profitable to give them definite names. Since, however, Kretzoi has done so, and since the ramus of *P. indicus* is evidently more slender than that of *P. pilgrimi* and M_1 relatively shorter, the two may provisionally be kept distinct, though I feel convinced that they are closely allied.

The referred M_1 from Bahitta (G. S. I. no. D 251) agrees exactly with M_1 in the holotype, though belonging to a slightly larger individual. Its better state of preservation enables traces of crenulation on the posterior edge to be seen distinctly. This conforms with those which are visible on P_3 of *Paramachaerodus pilgrimi.*

The upper canine from Hasnot (G. S. I. no. D 261) figured in Pl. viii, figs. 7, 7*a* lacks the greater part of the crown and the tip of the root. The estimated length of its crown is about 60 mm. Its cross section is oval but extremely elongate, the antero-posterior diameter at the base being 16 mm. and the transverse diameter 8·5 mm. There are two keels of which one is exactly posterior, while the other is placed slightly to the inside of the actual front, so that the outer surface between the keels is rather more convex than the inner surface. The portion of the anterior keel preserved is slightly convex and that of the posterior keel slightly concave. The posterior keel is sharper than the anterior one. On both keels a series of fine crenulations is plainly visible. The character of this tooth agrees closely with that of *Paramachaerodus orientalis* (Kittl). It seems somewhat too small for the holotype of *Paramachaerodus pilgrimi*, so that I provisionally refer it to *P. indicus.*

Genus : PROPONTOSMILUS, Kretzoi.

1929. *Propontosmilus*, Kretzoi, Proc. Intern. Congr. Zool. 1927, Budapest, p. 1297.

Diagnosis.—Machærodontinæ of small size, with rather stoutly built but shallow mandible; with a well developed mental crest; two small mental foramina; symphysis not very deep; base of canine somewhat above the level of the cheek teeth; distance between C and P_3 rather long, a rudimentary P_2 situated about midway between C and P_3; P_3 not reduced; M_1 rather robust, longer relatively to P_3 and P_4 than in *Paramachaerodus.*

Genotype.—Pseudaelurus sivalensis, Lydekker (1877, p. 83) [=*Aelurogale sivalensis,* Lydekker (1884, p. 317, Pl. xliv, fig. 7)].

PROPONTOSMILUS SIVALENSIS (Lydekker).

(Pl. VIII, fig. 8.)

1877. *Pseudaelurus sivalensis,* Lydekker, *Rec. Geol. Surv. Ind.,* X, p. 83.
1884. *Aelurogale sivalensis,* Lydekker, *Pal. Ind.,* (10), II, p. 317, Pl. xliv, fig. 7.
1913. *Sivaelurus* (?) *sivalensis* (Lydekker). Pilgrim, *Rec. Geol. Surv. Ind.,* XLIII, pp. 282, 291.
1915. *Paramachaerodus sivalensis* (Lydekker), Pilgrim, *Op. cit.,* XLV, p. 142.
1929. *Propontosmilus sivalensis* (Lydekker), Kretzoi, Proc. Intern. Congr. Zool. 1927, Budapest, p. 1298.
1929. *Machaerodus sivalensis* (Lydekker), Matthew, *Bull. Amer. Mus. Nat. Hist.,* LVI, p. 506.

Diagnosis.—This is the only known species and the diagnosis is that of the genus.

Holotype.—The right mandibular ramus containing the broken M_1 and the roots or alveoli of the canine and P_{2-4}, described and figured by Lydekker first under the name of *Pseudaelurus sivalensis* (1877, p. 83) and then under that of *Aelurogale sivalensis* (1884, p. 317, Pl. xliv, fig. 7). This is in the collection of the Geological Survey of India in Calcutta, regd. no. D 95.

Referred specimen.—A lower canine (G. S. I. no. D 262) from Hasnot figured in Pl. viii, figs. 7, 7*a* of the present work.

Locality.—The Salt Range, no precise village being indicated.

Horizon.—Probably the Dhok Pathan stage of the Middle Siwaliks.

Remarks.—The holotype was fully described by Lydekker (1884, p. 317), and further comments and comparisons of the specimen were made by myself (1915, p. 142). Its fragmentary nature renders it difficult to decide on its exact affinities, but the nature of the chin with its strong mental process and the relatively large lower canine show that it is allied to those Machaerodont species which have been classified under *Paramachaerodus.* This opinion seems to have been endorsed by Kretzoi and Matthew. On account of its obviously more primitive character Kretzoi established for it the new genus *Propontosmilus,* and although the fragmentary nature of the material is quite insufficient to define it properly, the name may be allowed to stand. Since comparing it with *Paramachaerodus,* I have been struck by the remarkable similarity in many ways between the holotype and the ramus from Pikermi described and figured by Wagner (1857, p. 121, Pl. v, fig. 11) under the name of *Machaerodus leoninus* and which I have recently referred provisionally to the genus *Epimachairodus* with the specific name of *taracliensis* (Pilgrim 1931, p. 132). M_1 is only slightly longer relatively to P_3 and P_4 than in the Pikermi ramus; the ramus is equally stout and shallow; the mental process is similar; the distance between the canine and P_3 is only slightly longer and the canine lies at a somewhat higher level than the cheek teeth much as in *Epimachairodus* (?) *taracliensis*. The Chinji species is obviously more primitive as shown by the presence of P_2, the less reduced P_3 and the larger lower canine which indicates a much shorter upper canine. These are the characters which might be expected in an ancestral form to *E. taracliensis*. That one Miocene species of *Propontosmilus* may have given rise to a branch leading to *Epimachairodus* (?) *taracliensis*, characterised by great development of the upper canines, and that another species may have been the ancestor of *Paramachaerodus*, in which the upper canines remained more normal, is not indeed inconceivable.

The right lower canine (G. S. I. no. D 262) from Hasnot figured in Pl. viii, figs. 8, 8*a* lacks the upper part of the crown and the lower part of the root. Its estimated length was about 25 mm. Its cross section is oval, slightly elongate, the antero-posterior diameter at the base being about 12 mm. and the transverse diameter about nine mm. There are two keels, of which one is exactly posterior, strongly convex and possesses a series of fine crenulations; the other is situated well on the inner side and is only represented by its base. It curves slightly to the rear near the base of the crown. It is hardly preserved high enough above the base to show much in the way of crenulation but traces of it are indistinctly visible. Its structure seems to agree with that of the lower canine of Machærodonts in general. It is too small for the base of the canine present in the holotype of *P. pilgrimi* and also is much less elongate in cross section. This seems to apply equally in the case of *P. indicus* and *P. schlosseri*, in the latter of which the lower canine is well preserved. On the other hand the cross section of the root is in exact agreement with the portion still left in the holotype of *Propontosmilus sivalensis*, and its more robust build is more in accord with that of *Epimachairodus* (?) *taracliensis* although it is relatively larger than in that species.

Genus: SIVASMILUS, Kretzoi.

1929. *Sivasmilus*, Kretzoi, Proc. Intern. Congr. Zool. 1927. Budapest, p. 1296.

Diagnosis.—Machærodontinæ of small size; with relatively slender mandible; with a moderately well developed mental crest; chin forming a more obtuse angle with the lower surface of the ramus than in other genera of Machaerodonts; with two mental foramina under P_2 and P_3 respectively; canine large, situated somewhat above the level of the cheek teeth, oval cross section, somewhat elongate but much less so than in *Paramachaerodus*, keels either absent or not very pronounced; distance between canine and P_3 rather long; a rudimentary P_2 situated about midway between the canine and P_3; P_3 considerably reduced, low-crowned, with weak posterior accessory cusp and cingulum, anterior accessory cusp absent; P_4 with a rather large posterior accessory cusp and a broad cingulum surrounding it on all sides; remaining teeth unknown.

Genotype.—*Sivasmilus copei,* Kretzoi (1929, p. 1297) [=*Sivaelurus chinjiensis* ? (Pilgrim, 1915, p. 149)].

SIVASMILUS COPEI, Kretzoi.

1915. *Sivaelurus chinjiensis* (?) Pilgrim, *Rec. Geol. Surv. Ind.*, XLV, p. 149, Pl. vi, figs. 2, 2*a*, 2*b*.

1929. *Sivasmilus copei,* Kretzoi, Proc. Intern. Congr. Zool., 1927, Budapest, p. 1297.

Diagnosis.—The diagnosis of this, the only known species, is that of the genus.

Holotype.—The left mandibular ramus with the canine and P_2 to P_4 described and figured by Pilgrim (1915, p. 149, Pl. vi, figs. 2, 2*a*, 2*b*) under the name of *Sivaelurus chinjiensis* (?) and subsequently named *Sivasmilus copei* by Kretzoi (1929, p. 1297). It is in the collection of the Geological Survey of India in Calcutta, regd. no. D 151.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Remarks.—The holotype has been fully described and figured (Pilgrim, 1915, p. 149). Its Machærodont nature seems to be indicated not only by the presence of a mental crest but also by the crenulations on P_3 and by its general resemblance to the mandible of *Propontosmilus sivalensis* (Lyd.) On the other hand both Kretzoi (1929, p. 1297) and Matthew (1929, p. 498) have pointed out that the maxilla of *Sivaelurus chinjiensis* is essentially Feline in character so that my provisional reference of the mandible to the latter species is almost certainly incorrect. While the relatively large size of P_4 and its general structure reminds one of *Paramachaerodus, Epimachairodus* and *Propontosmilus* the great reduction of P_3 is quite unlike either of those genera. It agrees with *Aeluarictis* in the great distance between the canine and P_3. That genus has an equally small P_3, but a very much simpler and shorter P_4. The chin slopes forward much less than in the Indian species. The situation of the rudimentary P_2 both in relation to the canine and P_3, as well as the size and shape of the canine is very similar to what is seen in *Propontosmilus sivalensis.* The forward slope of the chin is also closer to its character in the latter genus. The mental crest is, however, much less prominent and the ramus is more slender. Kretzoi considers that it stands between *Pseudaelurus africanus,* Andrews (=*Afrosmilus africanus,* Kretzoi) and *Propontosmilus sivalensis.* It is obviously a primitive form, but in the absence of further material its exact affinities must remain uncertain, and it was in order to avoid founding an ill-defined genus that I grouped it provisionally with *Sivaelurus.* Since, however, Kretzoi has given it a distinct generic name, this may be allowed to stand without much insistence on its taxonomy until such time as our acquaintance with its characters shall be increased.

Genus: MACHAIRODUS, Kaup.

1833. *Felis* (*pars*), Kaup, Oss. foss. Darmstadt. p. 18.

1833. *Machairodus,* Kaup, *Ibid.* p. 24.

1833. *Agnotherium,* Kaup, *Ibid.* p. 28.

1922. *Amphimachairodus,* Kretzoi, 10th Internat. Congr. Zool. p. 1316.

Diagnosis.—Machærodontinæ of large size; with long muzzle; upper canine, very large, stout, long, flattened; lower canine stout, rather compressed, oval in cross-section; mandible with deep symphysis; canines and incisors elevated considerably above the level of the back teeth; without mental process but with a prominent mental crest; P^3 and P_3 little reduced; P_3 similar in structure to P_4; P_3 and P_4 with accessory cusps only moderately developed and with little backward pitch of cusps. P^4 with protocone weak, paracone and parastyle well developed and with an extra cusp anterior to the parastyle (ectoparastyle); M^1 long, transverse, less reduced than in other genera; M_1 with vestigial metaconid; skeleton unknown, but assumed to be robust with stout limbs.

Genotype.—*Felis aphanista,* Kaup (1833, p. 18, Carnivora Pl. ii, fig. 1).

Remarks.—The history of the genus and the propriety of restricting it to a single European species, out of the many which have for some time past been known under the name *Machairodus* is discussed elsewhere (Pilgrim, 1931, pp. 126, 127).

Genus: Epimachairodus, Kretzoi.

1929. *Epimachairodus,* Kretzoi, 10th. Internat, Congr. Zool. p. 1310.

Diagnosis.—Machærodontinæ of large size; mandible with weak coronoid process; relatively shallow symphysis; with strong mental crest but without a mental process; incisors and canine not elevated above the level of the back teeth; incisors strong, with crenulated crests; upper and lower canines biting in opposition; upper canines very long, flat and broad; lower canines much reduced; back teeth highly specialised with crenulated crests. P^4 and P_4 with moderately developed accessory cusps; protocone of P^4 absent; P^3 and P_3 tending to reduction; M_1 with or without a metaconid; limbs long and slender.

Genotype.—*Epimachairodus hungaricus,* Kretzoi 1929.

Species.—Kretzoi has recognized four species in addition to the genotype:—*M. crenatidens,* Fabrini (1890) from the Upper Pliocene of the Val d'Arno; *E. boulei,* Kretzoi (1929) from the Upper Pliocene of Sainzelles; *M. latidens,* Owen (1846) from the Lower Pleistocene of Kents Hole, Torquay, England; and *E.* sp. Kretzoi from Doves Hole, Derbyshire, England, referred by Boyd Dawkins (1903) to *Machairodus crenatidens.* The species *M. taracliensis,* Riabinin (*see* Pilgrim 1931, p. 132) is provisionally included in the genus, though it is more primitive than the others named above.

Machairodus or Epimachairodus (?), sp. indet.

1884. *Machaerodus sivalensis* (Falc. & Caut.) Lydekker, *Pal. Ind.,* (10), II, p. 339, Pl. xliv, fig. 6.

1884. *Machaerodus palaeindicus,* Bose, Lydekker, *Ibid.,* p. 344, Pl. xliii, fig. 9.

1884. *Felis* non det. aff. *F. pardus*, Lydekker, *Ibid.*, p. 329, Pl. xliii, fig. 3.

The specimens here included are :—(1) an upper canine (G. S. I. no. D 105) collected by Theobald in the Siwaliks of the Punjab. This probably means the Salt Range. It was described and figured by Lydekker (1884, p. 339, Pl. xliv, fig. 6) under the name of *Machaerodus sivalensis ;* (2) an upper incisor (G. S. I. no. D 104), collected by Theobald at Hasnot, Salt Range. It was described and figured by Lydekker (1884, p. 344, Pl. xliii, fig. 9) under the name of *Machaerodus palaeindicus ;* (3) a lower canine (G. S. I. no. D 77) collected by Theobald in the Siwaliks of the Punjab, which probably means the Salt Range. It was described and figured by Lydekker (1884, p. 329, Pl. xliii, fig. 3) under the name of *Felis* sp. non det, aff. *F. pardus.*

In the case of the upper incisor (D 104) the horizon may with certainty be taken as the Dhok Pathan stage of the Middle Siwaliks. If my assumption that the other two specimens were collected in the Salt Range is correct then the chances are very greatly in favour of their belonging to the same horizon. In that case it may safely be predicated that neither of the three belong to the species to which Lydekker referred them respectively, since *Megantereon* (?) *palaeindicus*, *Megantereon* (?) *falconeri* and *Sivafelis potens*, the names by which the species in question are known in this work, are Upper Siwalik and very probably the Pinjor stage. Lydekker's references, therefore, fall to the ground for this reason alone. Apart from this, however, the upper canine seems to be too massive and probably too long for *Megantereon*, so that a reference to *Megantereon* (?) *praecox* or some allied species cannot be entertained. On the other hand it might easily belong to a Pontian species of *Machairodus.* In outline and curvature it agrees with the upper canine of *Machairodus palanderi*, Zdansky (1924, p. 109, Pl. xxiv, fig. 4), and though too small for that might belong to another species. One cannot even exclude the possibility that it might belong to a species allied to *Epimachairodus* (?) *taracliensis*, which is smaller than *E. crenatidens.*

The lower canine (D 77) is not only far too big for *Sivafelis potens*, but has characters which militate against its belonging to any species of *Panthera.* Not only are the keels too strong and too close together, but it is almost certain that traces of an original crenulation remain on them. Moreover the vertical groove on the outer side which most of the true Felines possess is here lacking. It is not too big for the ramus of *Machairodus tingii*, Zdansky (1924, p. 119, Pl. xxvii, fig. 3). The keels are too close together for *Epimachairodus* (?) *taracliensis* and the curvature is too great. This was one of the chief characters which no doubt influenced Lydekker in assigning it to *Felis*, and such a possibility cannot indeed be entirely excluded.

The upper third incisor (G. S. I. no. D 104) is more certainly that of a large Machærodont. As Lydekker has stated the absence of basal cusps on the palatal side of the tooth distinguishes it from *Epimachairodus latidens* and I may add equally from *Epimachairodus* (?) *taracliensis*, and *Megantereon. Machairodus* remains as the most likely genus to which it should belong.

The specimens here mentioned are not of great value for exact specific determination but they are interesting as showing that large Machærodonts allied to *Machairodus* existed in the Pontian of India as in that of Europe and China, and that these were not ancestral at any rate to the most common Machærodont types of the Upper Pliocene, *Megantereon* and *Epimachairodus* in Europe and *Megantereon* or a closely allied form in India.

Sub-family: *FELINÆ.*

Diagnosis.—Felidæ having teeth without crenulated crests; incisors progressively diminishing in size; canines generally with longitudinal furrows; upper canine progressively diminishing in size and lower canine progressively increasing in size, until approximate equality is reached; upper and lower carnassial teeth deeply notched between the lobes; P^3 with or without anterior cusp; P^4 almost always with strong protocone; weak paracone and parastyle; anterior accessory cusp rarely present; frontal region high; occipital low; mastoid and paroccipital processes approximately equal in size; condylar and carotid foramina joined with foramen lacerum posterius; glenoid fossa not depressed; mandible with long coronoid process; without mental crest or process; extremities slender; hallux reduced.

Genus: FELIS, Linné.

1758. Linné Syst. Nat. X, p. 41.

Diagnosis.—Felinæ of slender form; with short, high skull and strongly inflated auditory bulla; weak mastoid and paroccipital processes; small incisors; weak, conical, curved canines; premolars and molars simple not robust; P_3 without anterior cusp; claws retractile.

Genotype.—*Felis catus* Linné.

FELIS SUBHIMALAYANA, Bronn.

1836. *Felis sp.*, Baker and Durand, *Journ. As. Soc. Beng.*, V, p. 579, Pl. xxvii, fig. 1.

1848. *Felis subhimalayanus*, Bronn, Index Palaæntologicus, p. 492.

1884. *Felis subhimalayana*, Bronn, Lydekker, *Pal. Ind.*, (10), II, p. 330.

Diagnosis.—A *Felis* of small size, about equal to that of *Felis bengalensis*; with larger occipital condyles; lambdoidal crest more prominent; post-orbital processes more prominent; frontal more depressed behind the post-orbital processes; orbits smaller; auditory bulla more inflated and more elongate.

Holotype.—The skull described and figured by Baker and Durand (1836, p. 579, Pl. xxvii, fig. 1) under the name of *Felis* sp., and mentioned by Lydekker (1884, p. 330) under the name of *Felis subhimalayana,* which had been given to it by Bronn (1848, p. 492). It is in the Science and Art Museum, Dublin, no. 47 among Dr. Beattie's fossils.

Referred specimens.—Lydekker considered (1884, p. 331) that a mandibular-ramus and some associated limb bones described and figured by Baker and Durand (1836, p. 580, Pl. xxvii, figs. 2, 3), also in the Science and Art Museum, Dublin, probably belong to the same species as the skull.

Locality.—The Siwalik Hills.

Horizon.—Probably the Pinjor stage of the Upper Siwaliks.

Remarks.—I have not seen the holotype and Lydekker seems only to have made a brief examination of it, so that our knowledge of it rests mainly on Baker's and Durand's original description.

FELIS non det., allied to *Felis lynx.*

Lydekker (1884, p. 329, Pl. xliii, figs. 7, 7*a*) has described and figured under the above designation a fragment of the left mandibular ramus (G. S. I. no. D 90) which was collected by Theobald at Jabi in the Salt Range. There is no doubt that it belongs to the Dhok Pathan stage of the Middle Siwaliks. Lydekker has noted its resemblance to the species *Felis isabellina,* but considering its very much earlier date than any living or known fossil lynxes and equally the entremely meagre material, it would be unsafe to draw any conclusions from its supposed lynx-like character, as to the exact degree of relationship which it bears to the recent lynxes.

FELIS CHAUS, Guldenstadt.

Mainly on account of their size Lydekker has identified with this species a damaged mandibular ramus and an upper canine (G. S. I. no. F 228, 228*a*) which he figured (1886, Pl. vii, figs. 17, 18) from the Billa Surgam Cave deposit.

FELIS RUBIGINOSA, Geoffr.

Of rather more certain reference than some of the above are a maxilla and a mandibular ramus from the Billa Surgam Cave deposit (G. S. I. no. F 229) described and figured by Lydekker (1886, p. 30, Pl. vii, figs. 14, 14*a*, 15) under the above name. A humerus figured in Pl. vii, fig. 16 of the same work, was referred by Lydekker to the same species, chiefly on account of its size.

Genus: PANTHERA, Frisch 1775.

Diagnosis.—Felinæ of robust build; ectotympanic portion of auditory bulla extremely small and comprising little more than the external auditory canal; nose in the same plane as the forehead; face elongate, moderately high, broad, flattened above; orbit of moderate size; upper process of premaxilla very narrow and much produced up the side of the maxilla, often one third the length of the nasal; hyoid bone imperfectly ossified and largely replaced by a long elastic ligament.

Remarks.—Pocock (1929, p. 506) has shown that the ligamentary structure of the hyoid bone is a character shared amongst living Felinæ only by the species *Felis pardus, F. leo, F. tigris, F. onca* and *F. uncia.* He has pointed out (Pocock, 1930, p. 331) that the last named species is distinguished from the first four by the much larger size of the ectotympanic portion of the auditory bulla, which is almost equal to the entotympanic. He has emphasised the inconstancy of dental and other characters, which have often been held to justify the generic separation of the first four species mentioned above, and therefore has united them in the single genus *Panthera,* retaining *F. uncia* in the genus *Uncia.*. I have adopted Pocock's classification in spite of the fact that the hyoid bone is not preserved in fossil forms. The species *Felis cristata,* however, so closely resembles one or other of the four living species of *Panthera* in its skull characters that I have no hesitation in including it in that genus.

PANTHERA CRISTATA (Falconer & Cautley).

1836. *Felis cristata,* Falconer & Cautley, *As. Research.* XIX, p. 135, Pl. xxi, figs. 1,2.
1868. *Felis cristata,* Falconer, *Pal. Mem.* I, p. 315, but not Pl. xxv, figs. 1-4 erroneously so described in plate description, which is *Crocuta felina,* Bose.
1868. *Felis palaeotigris,* Falconer, Pal. Mem. I, p. xxi.
1880. *Felis grandicristata,* Bose, *Quart. Journ. Geol. Soc.,* XXXVI, p. 127.
1880. *Uncia cristata* (Falc. & Caut.) Cope, *Amer. Nat.,* XIV, p. 853.
1880. *Uncia grandicristata* (Bose) Cope, *Ibid.*
1884. *Felis cristata* Falc. & Caut., Lydekker, *Pal. Ind.,* (10), II, p. 320, Pl. xl, figs. 1, 2; pls. xli, xlii.
1929. *Tigris cristatus* (Falc. & Caut.), Kretzoi, *Mag. Kir. Foldt. Int. Haziny. Budapest,* p. 14.

Diagnosis.—A *Panthera* of slightly smaller size than the average of *P. tigris*; having the facial considerably shorter than the cranial region; with a strongly developed sagittal crest; occipital deeper and overhanging the condyles to a greater extent than in *P. tigris;* condyles relatively larger; glenoid fossa expanded antero-posteriorly at its outer extremity; periotic region nearer to the glenoid fossa than in *P. tigris;* mastoid process, paroccipital process and auditory bulla larger and more prominent; zygomatic arches wide, anterior root of its jugal process deeper and more arched than in *P. tigris,* approximately equal to the vertical diameter of the orbit; nasals at approximately the same level as the upper process of the maxilla which is blunted; basal process of the frontal very short; post-orbital processes not prominent; interval between the upper canine and P^3 greater than in *P. tigris*; P^4 relatively larger.

Holotype.—The skull described and figured by Falconer and Cautley (1836 p. 135, Pl. xxi, figs. 1, 2) and more fully described and figured by Lydekker (1884, p. 320, Pls. xli, xlii). It is in the Museum of the Royal College of Surgeons, London.

Referred specimens.—The hinder part of a skull (Br. Mus., no. 49176) described and figured by Lydekker (1884), p. 146, Pl. xl, fig. 1).

The hinder part of a skull (Br. Mus. no. 49175) described by Bose (1880 p. 127) under the name of *Felis grandicristata* and figured by Lydekker (1884, Pl. xl, fig. 2).

There are two fragments of the mandibular ramus in the British Museum (Br. Mus. nos. 48437 and M 1567) described respectively by Bose (1880 p. 125 Pl. vi, fig. 4) and Lydekker (1884, p. 164, Pl. xliii, fig. 8) under the name of *Machaerodus palaeindicus.* Matthew (1929, pp. 494, 505) considered that these are not Machærodontine and that one if not both may belong to *Felis cristata.*

Locality.—The holotype skull was obtained by W. Ewer from the Siwalik Hills. The referred specimens also came from the Siwalik Hills.

Horizon.—Probably the Pinjor stage of the Upper Siwaliks.

Remarks.—Lydekker has so fully described the holotype and the referred skulls that nothing need be added to his description. He considered that it was in some respects intermediate between *Panthera tigris* and *Panthera leo* and also showed analogies to *Panthera onca,* but could not be referred to any described species.

Matthew (1929, p. 494) considered that the absence of any trace of a mental process in the two referred mandibles (Br. Mus. nos. 48437 and M 1567) prohibited the reference to *Megantereon palæindicus.* He doubted whether the differences in P_4 would allow of their being placed in the same species, but thought that at any rate one of them could be placed with *Felis cristata.*

PANTHERA TIGRIS (or ? LEO) (Linné.)

Lydekker (1886, p. 29, Pl. vii, fig. 20) has rather doubtfully referred to *Felis* with the above designation a portion of a P^4, a tibia and some foot bones from the Billa Surgam Cave deposit in the Karnul district. These are registered nos. F 224, 224 *a—d* in the G. S. I. collection in Calcutta.

(?) PANTHERA PARDUS, Linné.

From the same deposit as the above and of still more doubtful reference are a phalangeal (G. S. I. no. F 225) figured by Lydekker (1886, Pl. vii, fig. 19); and a metacarpal (G. S. I. no. F 225*a*).

Genus: SIVAFELIS[1] nov.

Diagnosis.—Felinæ of medium to moderately large size; with an extremely stoutly built and relatively short mandible; symphysis relatively short and steep; angle between the front surface of the chin and the surface of the ramus greater than a right angle; masseteric fossa rather deep and well defined, extending forward to the hinder end of M_1; incisors farther forward than in *Panthera* but less forward than in *Acinonyx;* canine almost symmetrically oval, rather large but relatively somewhat inferior in size to that of *Panthera*; keels apparently not very strong; post-canine diastema short; P_3 and P_4 as in *Panthera* but with higher main cusp and higher and better developed accessory cusps; M_1 with protoconid distinctly longer than paraconid; metaconid absent or represented by the merest rudiment; P^4 (from referred maxilla) moderately long; paracone shorter than metacone; parastyle strong; protocone well developed, situated far forward; M^1 small.

Genotype.—Sivafelis potens, sp. nov.

Species.—I include in this genus *Felis* (? *Cynælurus*) *brachygnatha* Lydekker (1884, p. 326) and *Cynailurus pleistocænicus* Zdansky (1925, p. 23) from Shansi, China.

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[1] I regret that I cannot avail myself of Kretzoi's names, *Sivapanthera* or *Abacinonyx* (*see* p. 202). Apparently *Sivapanthera* antedates *Abacinonyx,* but in justice to its author I cannot employ it, since he does not admit that its genotype is congeneric with the holotype of *Felis brachygnatha.* I am, therefore, forced to employ a new generic name with a different genotype.

SIVAFELIS POTENS, sp. nov.

(Pl. III, figs. 2, 10.)

1884. *Felis* (non. det.; allied to *Felis pardus*), Lydekker, *Pal. Ind.*, (10), II, p. 328, Pl. xliii, figs. 4, 4*a*.

Diagnosis.—A *Sivafelis* of smaller size and with relatively somewhat deeper and stouter mandible than in the other species: symphysis extremely short and steep; canine relatively smaller; metaconid of M_1 absent or merely rudimentary.

Holotype.—The right mandibular ramus figured in Pl. iii, figs. 2, 2*a*, 2*b* of the present work. It is in the collection of the Geological Survey of India in Calcutta regd. no. D 222.

Referred specimens.—The left mandibular ramus (Br. Mus. no. 16537*a*) from the Siwalik Hills described and figured by Lydekker (1884, p. 328, Pl. xliii, figs. 4, 4*a*) under the name of *Felis* (non det.; allied to *Felis pardus*), and briefly mentioned by Matthew (1929, p. 495) as *Felis* aff. *pardus.*

A fragment of the left maxilla with P^4 and the alveolus of M^1 (G. S. I. no. D 265) from Jharakki, Salt Range, in beds mapped by Aiyengar as Upper Siwalik, figured in Pl. iii, figs. 10, 10*a* of the present work.

Locality.—The type locality is Moginand in the Siwalik Hills. The referred ramus also came from the Siwalik Hills without any more definite locality having been recorded. The referred maxilla was collected at Jharakki, Salt Range area.

Horizon.—The Pinjor stage of the Upper Siwaliks.

Description.—The holotype is considerably damaged, lacking the coronoid process, the condyle and the angle. The front of the masseteric fossa is preserved. The crowns of the incisors and canine are missing and the summits of the main cusps in P_3 and P_4 and the hinder portion of the top of the blade of the protocone in M_1 are broken off. It is, however, possible to infer most details of the structure from the portions of the mandible and the dentition which are still present. The dimensions of the specimen are in the table on page **173**. The ramus is markedly concave in an antero-posterior direction on the inner side and convex on the outer side. It is extremely stoutly built but is short, with a very short post-canine diastema. The masseteric fossa is rather deep and extends forward at least to the end of M_1, possibly still further. Since its front border is obscured by matrix, it is impossible to say precisely. The canine is rather large and oval-elongate, but the absence of the entire crown except the very base does not enable very exact conclusions to be drawn as to its shape and structure. The incisors are not preserved, but the alveolus of I_3 shows clearly that the incisors lay more in front of the canine than in most other Felinæ; this is equally indicated by the shape of the chin which forms an angle of about 115° with the surface of the ramus. M_1 is, as usual in most of the Felinæ, about two thirds of the united lengths of P_3 and P_4. The protocone is distinctly longer than the paracone. The notch between them is very pronounced. There is a faint projection at the base of and behind the crown, which probably represents a vestige of a metaconid, which is, therefore, practically absent.

P_4 had evidently a high main cusp, which is relatively much less elongated in an antero-posterior direction than in *Panthera pardus* or even *Acinonyx jubatus* so that its keels were much steeper than in either of the forms named. On the contrary both the anterior and posterior accessory cusps are much more strongly developed than in *Panthera pardus.* There is a strong posterior cingulum, almost developed into an actual cusp. There is no external cingulum but on the inner side of the posterior accessory cusp there is a broad cingular shelf at a lower level than the semi-cusp which is situated immediately behind the posterior accessory cusp. P_3 is very similar to P_4 but the accessory cusps are lower, there is no posterior cingulum and the internal cingular shelf is narrower.

The left mandibular ramus (Br. Mus. no. 16537*a*) described and figured by Lydekker as *Felis* (non. det.; allied to *F. pardus*), though more fragmentary than the holotype closely resembles it in regard to those features which admit of comparison.

The referred left maxilla from Jharakki (G. S. I. no. D 265) contains the little worn P^4 of which the measurements are given in the table on page 172. The paracone is distinctly higher than but somewhat shorter than the metacone, being separated from it by a deep notch. The summit of the parastyle is broken off, but it was evidently a strong cusp, more than half the length of the paracone. Its front edge is slightly abraded, but I do not think that there was a cusp in advance of it. The protocone is situated on a level with the parastyle, and lies well to the inside of it. A sharp ridge runs forward from the summit of the paracone right to the end of the protocone, such as we find in some species of *Felis,* so that no large conical cusp is differentiated as is the case in *Panthera,* only a small narrow cusp. There is a hollow between this ridge and the parastyle. M^1 seems by its alveolus to have been a small tooth not extended transversely and lying on the inside of and somewhat behind P^4. The size of P^4 perfectly corresponds with that of M_1 in the holotype, so that there is strong reason to believe that it belongs to the same species, since remains of Felidæ are not so common in the Upper Siwaliks, as to suggest that there were two different species of the same size.

Comparisons.—The short jaw and contracted post-canine diastema invite a comparison with *Acinonyx* alone among recent Felinæ, and also with the species *Felis brachygnatha,* Lydekker (p. 202) and *Cynailurus pleistocaenicus,* Zdansky, which have been assigned to the genus *Acinonyx* by their authors. The diastema is, however, relatively longer than in the recent *Acinonyx jubatus.* Other features in which the present species resembles *Acinonyx* are the more pronounced accessory cusps of the lower premolars; the steep, short symphysis; the forward position of the incisors with its accompaniment of a chin which is inclined at an obtuse angle to the ramus. On the contrary the extremely slender ramus of *Acinonyx*; the narrow teeth; the more complicated P_3, which has a posterior cingulum; the smaller more compressed canine; the greater equality in length between the protoconid and paraconid in M_1; the presence of a small heel (rudimentary metaconid); and the shallower and less advanced masseteric fossa seem to me to prohibit not only any idea that the present species can be in any way ancestral to *Acinonyx* but even the propriety of placing it in the same genus.

If as seems extremely likely, the maxilla (G. S. I. no. D 265) belongs to the same species as the holotype, then the protocone of P^4 is a distinct cusp, instead of being reduced to a mere lobe without a cusp as in *Acinonyx.* It is also situated very far forward, whereas in *Acinonyx,* the internal lobe is opposite the paracone. Moreover the metacone is relatively shorter in the recent genus.

There seems to me far more to be said in favour of the present species being on the line of *Panthera,* to which it is allied by its robustness; the broad teeth; the shape of the masseteric fossa; the large canine; the structure of M_1 and the absence of a metaconid; and the structure of P^4 in the referred maxilla. The ramus is even more robust relatively than in any *Panthera;* while the curved shape of the ramus is unlike that of the latter. Moreover the features mentioned above in which this species resembles *Acinonyx* militate against a genetic connection with *Panthera.*

SIVAFELIS BRACHYGNATHUS (Lydekker).

1884. *Felis* (*?Cynælurus*) *brachygnatha,* Lydekker, *Pal. Ind.,* (10), II, p. 326, Pl. xliii, figs. 1, 1*a,* 2, 2*a.*

1929. *Acinonyx brachygnathus* (Lydekker), Kretzoi Proc. Intern. Congr. Zool. 1927. Budapest, p. 1330.

1929. *Sivapanthera lydekkeri,* Kretzoi, *Ibid.,* p. 1324.

1929. *Abacinonyx brachygnathus,* Kretzoi, *M. kir. Foldt. Int. Haziny. Budapest,* V, 24, p. 11.

Diagnosis.—A *Sivafelis* of larger size than *S. potens,* with a somewhat shallower and less robust mandible; accessory cusps of lower premolars somewhat lower; P_3 with a posterior cingulum; M_1 rather less than two thirds of the united lengths of P_3 and P_4; incisors still more in advance of the canine than in *S. potens.*

Holotype.—The right mandibular ramus with I_2-M_1 described and figured by Lydekker (1884, p. 326, Pl. xliii, figs. 1, 1*a*) under the name of *Felis* (*? Cynælurus*) *brachygnatha.* It is in the British Museum regd. no. 16573.

Referred specimen.—The right mandibular ramus (Br. Mus. no. 16537) from the Siwalik Hills with the alveolus of the canine and P_3-M_1 described and figured by Lydekker (1884, p. 327, Pl. xliii, figs. 2, 2*a*) under the name of *Felis* (*?Cynælurus*) *brachygnatha.*

Locality.—The Siwalik Hills.

Horizon.—Probably the Pinjor stage of the Upper Siwaliks.

Remarks.—The holotype and the referred ramus have been fully described by Lydekker who suggested their affinity to the modern genus *Acinonyx* (=*Cynaelurus*). Zdansky (1925, p. 23) has also referred the Chinese species *Sivafelis pleistocaenicus* to the genus *Acinonyx* without a query. This is sufficiently close to the Indian species for Matthew to regard it as a synonym, and in any case I have no doubt that it is generically the same. Matthew's (1929, p. 494) comment on the generic reference is that it was made upon rather inadequate grounds. He, however, had no hesitation in referring the ramus (Br. Mus. no. 16537) to the same species as the holotype. Kretzoi (1929, p. 1330) definitely assigned the holotype to the genus *Acinonyx*, in a later publication to a new genus *Abacinonyx*, but on the other hand considered that the ramus (Br. Mus. no. 16537) was not only specifically but also generically different, and gave it the name of *Sivapanthera lydekkeri*. It seems quite possible that Kretzoi's separation of the two rami was the result of a comparison based mainly on the figures. Since the holotype has every single tooth damaged and in particular lacks the front portion of P_3, injuries which are inadequately represented in the figures or emphasised in Lydekker's description, it can easily be understood that a false impression may have been created. Every single one of the characters given in Kretzoi's diagnosis of *Sivapanthera* apply equally to *Sivafelis brachygnathus*, except the statement that the masseteric fossa begins far behind M_1. With regard to this it is probable that in both specimens it begins in identically the same place, opposite the hinder end of M_1, its front part being obscured by matrix.

Most of the observations which I have already made on *Sivafelis potens* are equally applicable to *S. brachygnathus*, and both the rami evidently differ as markedly from *Acinonyx jubatus* as does the holotype of *Sivafelis potens*. Both these rami, but especially Br. Mus. no. 16537, show the beginning of the coronoid process which is entirely missing in *S. potens*. This is indicative of a steep high process, quite unlike the low gently sloping one of *Acinonyx jubatus*. Specific separation is justified not only on the score of size, but also by the slightly smaller relative size of M_1; the presence of a posterior cingulum in P_3; the shallower and slightly less robust ramus; and the slightly more advanced position of the incisors, with a correspondingly more oblique chin. *Sivafelis pleistocaenicus* (Zdansky) seems to differ somewhat more widely in its shallower and longer symphysis, its larger canine, the stronger heel (metaconid) on M_1 and the more backward position of the incisors.

Matthew (1929, p. 494) considers that 'there is little except geographical distance to separate *Felis brachygnatha* from *Felis arvernensis*.'

Genus: SIVÆLURUS, Pilgrim.

1913. *Sivaelurus*, Pilgrim, *Rec. Geol. Surv. Ind.*, XLIII, pp. 314, 282, 291.

Diagnosis.—Felinæ of moderately large size; with high, short face; moderate-sized orbits; moderate-sized infra-orbital foremen, opening into a shallow fossa; zygomatic arch probably slender; maxilla at the base of the zygomatic process not overhanging the teeth to any appreciable extent; upper canine rather large, with oval cross-section, not very elongate, probably without prominent keels; cheek teeth without any diastema; M^1 much elongated transversely, transverse almost three times the antero-posterior diameter; moderately well marked paracone and metacone; metacone almost directly internal to paracone; protocone prominent; P^4 of moderate length; paracone much longer and higher than metacone; parastyle well marked but low; anterior accessory cusp well marked but small, external to parastyle; protocone well developed, lying far forward, opposite the parastyle, but not very far removed from it internally; P^3 somewhat reduced, rather broad, with slight internal lobe, main cusp high, posterior accessory cusp well developed but low, well marked posterior cingulum, anterior accessory cusp rudimentary; P^2 small, single-rooted, rather elongate.

Genotype.—Pseudaelurus chinjiensis, Pilgrim (1910, p. 65; **1915**, p. **145**, Pl. vi, figs. 1, 1*a*).

SIVÆLURUS CHINJIENSIS, Pilgrim.

1910. *Pseudaelurus chinjiensis*, Pilgrim, *Rec. Geol. Surv. Ind.*, XL, p. 65.
1913. *Sivaelurus chinjiensis*, Pilgrim, *Op. cit.*, XLIII, pp. 314 footnote, 282, 291.
1915. *Sivaelurus chinjiensis*, Pilgrim, *Op. cit.*, **XLV**, p. 145, Pl. vi, figs. 1, 1*a*.

Diagnosis.—The diagnosis is that of the genus.

Holotype.—The right maxilla described and figured by Pilgrim (**1915**, p. **145**, Pl. vi, figs. 1, 1*a*). It is in the collection of the Geological Survey of India regd. no. D 150.

Locality.—Chinji, Salt Range.

Horizon.—The Chinji stage of the Lower Siwaliks.

Description.—The description of this species which I have already given (Pilgrim **1915**, p. **145**), may with advantage be amplified with some further details. Since the maxilla does not appear to be distorted, it is evident that that part of it which lies above P^4 does not overhang it to any great extent, and it is also probable that the zygomatic arches were slender and did not project far outward. The anterior border of the maxilla is almost vertical forming a right angle with the plane of the cheek teeth. The actual infra-orbital foramen is hardly bigger than in *Panthera pardus*, but it opens out in front into a well marked and comparatively deep fossa. The greater height and length of the paracone of P^4 relative to the metacone is very noticeable. The striæ previously remarked as existing on the blade of the paracone are less distinct than was formerly the case, probably due to the slight abrasion caused by the casting of the specimen, but traces of them are still visible. Considering the early stage of wear it is improbable that any crenulation which the teeth possessed was other than extremely slight. This also applies to P^3. The alveolus of P^2 fills up the entire space between P^3 and the canine and its shape indicates that it was a distinctly elongate tooth. Zdansky's (1924, p. 130) suggestion that the portion of the canine left in the alveolus is insufficient to show whether the crown possessed keels or not is probably quite sound. At the same time the less compressed base leads one to infer that such keels are not likely to have been as prominent as in *Metailurus.* The root of the canine seems to have been comparatively short and straight, without the marked curvature which characterises that of *Panthera pardus.* In M^1 the paracone and metacone are connected by a crest, concave on the hinder side, the metacone occupying only a very slightly posterior position to the paracone. The antero-posterior diameter of the tooth is much less on the internal than on the external side, although the protocone is comparatively prominent and situated at a considerable distance to the inside of the other two cusps of M^1.

Remarks and comparisons.—I quite agree with Kretzoi's (1929, p. 1272) and Matthew's (1929, p. 498) opinion that the ramus (G. S. I. no. D 151) is unlikely to belong to the same species or genus as the holotype of *Sivaelurus chinjiensis,* a provisional reference which I (Pilgrim, 1915, p. 149) originally suggested. This ramus is described above (page 193) under the name of *Sivasmilus copei,* Kretzoi. Kretzoi (1929, p. 1330) has classified *Sivaelurus* with the recent genus *Acinonyx* in the subfamily of the Acinonychinæ. This classification seems to me too nebulous to be seriously considered. The utmost that can be said in favour of a connection between *Sivaelurus* and *Acinonyx* is that in case the genus *Acinonyx* happens to be a recent specialisation, which indeed is possible since no immediately ancestral forms are so far known, then the genus *Sivaelurus* may be as much ancestral to it as to *Panthera pardus* or to many other Feline genera. If on the other hand the origin of the peculiar characters of *Acinonyx* lies farther back in the geological record, then any affinity between the Chinji and the recent genus is certainly negatived. The following important differences between the two genera may be noted :—the root of the zygomatic process overhangs the teeth considerably more in *Acinonyx* than in *Sivaelurus ;* the infra-orbital foramina are two in number, minute, rather remote from the orbit and not lodged in anything approaching a fossa ; the front edge of the maxilla forms an acute angle with the plane of the cheek teeth, whereas in *Sivaelurus* it forms a right angle ; M^1 is reduced to a mere circular crown in *Acinonyx ;* in P^4 the paracone is shorter, the parastyle is higher and more prominent, the anterior accessory cusp is less developed, the protocone lies much more to the rear, practically opposite the paracone and is reduced to a mere lobe, without any trace of a cusp ; P^3 is much longer and more slender, with a much more prominent posterior accessory cusp and cingulum and an equally prominent anterior accessory cusp, rudimentary in *Sivaelurus* ; P^2 is smaller and circular instead of elongate ; the canine is much smaller and less elongate in cross-section. In the face of these differences no more significance must be attached to the fact that both forms possess a short muzzle, than to my own original suggestion that a possible genetic connection existed between *Sivaelurus* and the recent *Felis nebulosa.*

The only Machærodontine genera of which the possible affinity to *Sivaelurus* could be considered are *Paramachaerodus* and some allied genera. The upper canines in these forms are, however, much longer and more compressed. Matthew (1929, p. 498) has very pertinently pointed out that the affinities of the holotype of *Sivaelurus* lie with the Felinæ. I had already commented on its primitive features :—the unreduced M^1 ; the long paracone of P^4 ; the height and short crown of P^3 and the elongate P^2.

There seem to be considerable resemblances between the Chinji genus and the Chinese *Metailurus* (Zdansky, 1924, pp. 123, 137), as Zdansky has pointed out. *Sivaelurus* is certainly in an earlier stage of evolution, as shown by the greater transverse diameter of M^1 and the presence of P^2. P^3 and P^4 are very similar, but the protocone of P^4 appears to be less forwardly situated in *Metailurus* than in *Sivaelurus*, and the canine is more compressed and has probably more pronounced keels. The zygomatic processes also appear to be much wider than in *Sivaelurus.*

Pseudaelurus is more primitive than *Sivaelurus* in the longer diastema, the longer P^3, the broader protocone of P^4 and the stronger anterior accessory cusp (ectoparastyle).

Genus: VISHNUFELIS, nov.

Diagnosis.—Felinæ of medium size; with an extraordinarily low skull in relation to its length and still more so in relation to its total breadth at the zygomatic arches; face very elongate; incisor alveoli as far in front of the post-orbital processes as the occipital crest is behind them; breadth at post-orbital processes greater than at the muzzle; nasals short and rather narrow; anterior nasal foramina rather small and narrow, opening above rather than to the front; orbit rather large; post-orbital processes rather prominent; frontal hollowed between them; maxilla falling at a rather gentle slope to the teeth; infra-orbital foramen of moderate size, close to the orbit, opening on to a slightly concave surface in front; zygomatic arches exceedingly wide and prominent; brain case relatively narrow; width at mastoid but little exceeding that at the post-orbital processes; mastoid process prominent; paroccipital process equally prominent; upper canine procumbent, rather long but with crown shorter than root; outer surface curved inward; inner surface rather flat and concave in a vertical direction; posterior keel rather strong; anterior keel obscure; lower canines much smaller than upper canines; and probably less elongate; a long interval between the canine and P^3, in the middle of which is a rudimentary P^2; P^3 having a smaller antero-posterior diameter than the canine; P^4 with a prominent protocone.

Genotype.—*Vishnufelis laticeps*, sp. nov.

VISHNUFELIS LATICEPS, sp. nov.

(Pl. IX, fig. 1.)

Diagnosis.—The diagnosis is that of the genus.

Holotype.—The associated portions of a skull figured and partially reconstructed in Pl. ix, figs. 1, 1*a*, 1*b* of the present work. They are in the collection of the Geological Survey of India in Calcutta, regd. no. D 266.

Locality.—The holotype was collected by K. Aiyengar from 2¾ miles east of Paridarwaza in the Jhelum district, Salt Range area.

Horizon.—The Chinji stage of the lower Siwaliks.

Description.—The skull as given to me consists of two main fragments, and some smaller pieces which cannot be fitted in to any portion of the other two. The first of the larger fragments contains the major part of the right maxilla and premaxilla lacking the bar which encloses the infra-orbital foramen, the upper end which joins the frontal, and everything behind P^3, except the front edges of the alveoli of the two anterior roots of P^4. P^3 is only represented by its roots, and the rudimentary P^2 equally only by its root. The upper canine has lost its tip but the lower part of the crown is moderately well preserved. A small portion of the lower canine, just below the tip is cemented in the diastema between the upper canine and I^3. The matrix, which surrounds the lower canine and the upper incisors, is extremely hard and has not been removed. The front surface of the crowns of the lower canine and of I^3 can be distinctly seen and parts of the roots of I^1 and I^2 are obscurely visible. The right premaxilla seems otherwise to be well preserved and shows the entire edge bordering the nasal foramen as well as the sutures with the maxilla and the nasal. A small part of the left premaxilla is also preserved on the left hand side of the median suture. A narrow surface of the palate has been cleanly developed out of the matrix, extending from the incisors back to the front alveoli of P^4.

The second fragment of this skull is the larger and shows a great part of the right side of the cranium from the fronto-nasal suture back to the level of the paroccipital process. A small part of the left frontal is also preserved showing the median suture distinctly. Small portions are missing from the upper edge of the orbit and the tip of the post-orbital process, also the entire zygomatic arch, although the junctions of both the jugal and the squamosal portions of it with the rest of the skull are well shown. The extreme hinder portion of the skull including almost all the lambdoidal crest, the occipital and the condyles is completely broken away. Most of the basi-cranial region is obscured by matrix and even those parts of it which are clear of matrix are much damaged. The auditory bulla has been destroyed. The end of the mastoid process is broken but most of the paroccipital process is preserved. The inner portion of the glenoid fossa is visible, and the fractured base of the corresponding part of the glenoid crest.

These two fragments do not join, there being a greater or less interval between the broken surfaces. It was, therefore, essential in order to form an idea of the characters of the skull, that these missing portions should be restored. The parts which are present seem to afford sufficient data to enable the restoration represented in the drawings in Plate ix, figs. 1, 1*a*, 1*b* to be attempted. It is impossible to hope that this is entirely correct, since there is such a wide margin for error. The orientation of the fragments in the horizontal plane has been based on the palatal surface and the summit of the frontals between the post orbital processes; it has been possible to fix the median antero-posterior line on account of the circumstance that small portions of both the left premaxilla and the left frontal have been preserved. The actual distance left between the two fragments has been decided to be that which will enable the various parts as placed to be joined up as naturally as possible. Certain very definite peculiarities of structure emerge into notice from the reconstruction as so effected, such as the very short nasals, the extraordinary outward projection of the zygomatic arches and their great width; the procumbency and inward curvature of the canine; the marked elongation of the skull in front of the post-orbital processes; its small height everywhere. I fail to see that any possible reconstruction could alter these features in any essential degree. From the highest point of the frontal, opposite the post-orbital processes, the profile falls gently and equally towards the front and rear. The post-orbital processes are rather prominent but their tips do not bend down very appreciably. Their front edge is continued into a prominent rim which forms the upper border of the orbit. Internal to this the frontal surface is markedly depressed, rising again towards the median line. The mastoid process, though its tip is missing, was evidently very prominent. The paroccipital process exists in a fair state of preservation immediately behind the former position of the auditory bulla, as a transversely elongated narrow ridge, broadening towards the outside and continued to the rear as a stout ridge at right angles to the other. These two ridges enclose a deeply hollowed surface just in front of the condyles, which is very similar to what we find in *Neofelis nebulosa,* though it slopes forward more than in the recent species. The glenoid fossa is extremely broad in an antero-posterior direction and behind it the broken base of the glenoid crest is visible, and behind this the large post-glenoid foramen. The bulla seems to have been smaller and less elongate antero-posteriorly than in *Neofelis nebulosa.*

P^3 is represented merely by its two roots of approximately equal size, which show that it was of small size relatively to the length of the skull and jaw. The root of P^2 was minute and lies about midway between P^3 and the canine. The upper canine had a long crown but shorter than the root; its outer surface is very convex both in a vertical and horizontal direction, while the inner surface is very concave in a vertical direction and only slightly convex in a horizontal one. A posterior keel is noticeable but an anterior one is obscure. It is impracticable to give many measurements, but the figures in Plate ix are drawn exactly natural size, so that any comparisons desired can be made from them. The ones given on page 209 may perhaps be useful.

Remarks and comparisons.—That the skull belongs to one of the Felidæ can hardly be doubted, in view of the identification of the tooth of which the front edges of two alveoli are visible as P^4. This is indicated not only by the position and size of the inferred protocone, but also by the position of the infra-orbital foramen immediately above the front end of the tooth in question. Consequently the anterior premolar series is much reduced. There seems to be no room for an extended molar series as in the Canidæ. Moreover the shape of the upper canine is essentially Feline, as is the general shape and profile of the upper portion of the skull. It is, however, an extremely primitive form, as shown by the elongate skull, especially the jaw, the long interval between P^3 and the upper canine, the excess of size of the upper over the lower canine and the lowness of the skull, especially marked in the frontal region. The character of the upper canine, which is not unduly enlarged; nor especially compressed; does not possess a prominent posterior keel and no anterior one; is without crenulated edges; and also the low occiput without a marked sagittal crest; prohibits classification with the Machærodontinæ. If it belong to the Proailurinæ, it could only be a very advanced member of that subfamily, because of the extremely reduced anterior premolar dentition, and it bears no close relation to *Vinayakia* nor probably to *Mellivorodon*, because of the absence of the internal root and lobe in P^3 and the small size of P^2. I find it necessary, therefore, to include it in the subfamily of the Felinæ.

The nearest affinity to a recent Felid lies with *Neofelis nebulosa* on account of its profile, low skull, long upper canine, prominent mastoid process and shape of the paroccipital process. In that species, however, P^3 is less reduced; the interval between P^3 and the canine is less; the hinder portion of the skull is longer; the breadth at the post-orbital processes is much less; the zygomatic arches project much less to the outside and are much narrower; the nasals are longer; the upper canine is less compressed, much less curved inward, and not procumbent. In regard to the greater skull breadth it comes nearer to *Panthera* and some other Felinæ, but in these the height is much greater; the profile different; the face shorter; and the upper canine relatively smaller, less compressed and different in shape. In no species that I know except *Stenogale julieni* (*see* Viret, 1929, Pl. xii, fig. 5), does the maxilla take such a strong outward bend as in the present specimen, which implies a wide zygomatic arch, correlated with an extraordinarily broad glenoid fossa and a prominent mastoid process. The inward curvature of the upper canine and its procumbency are equally features to which I have found no parallel, though it is possible that in the former feature some resemblance may be found in an isolated upper canine from Elm described by Stehlin (1917, p. 193, figs. 1, 2), and made by Kretzoi (1929, p. 1323) the type of a new genus *Elmensius*. This canine is, however, keeled on the anterior as well as on the posterior side.

Measurements.

Estimated breadth between post-orbital processes		63 mm.
Estimated breadth at mastoid processes		70 mm.
Estimated breadth behind canines		42 mm.
Upper canine	antero-posterior diam. at base	12·5 mm.
	transverse diam. at base	8·5 mm.
Estimated length of P^3		11·5 mm.
Distance between P^3 and canine		9·0 mm.

LIST OF LITERATURE.

Abel, O.

1928 . . . . . *See* Weber, Max.

Alexejew, A. K.

1915 . . . . . Animaux Fossiles du village Novo-Elisavetovka, pp. xiv + 453, Pls. i-x, 8vo. Odessa.

Andree, J.

1926 . . . . . Neue Cavicornier aus dem Pliocän von Samos. *Palæontographica*, LXVII, pp. 135-175, Pls. x-xvi.

Andrews, C. W.

1914 . . . . . On the Lower Miocene Vertebrates from British East Africa. *Quart. Journ. Geol. Soc. London*, LXX, pp. 163-186, Pls. xxvii-xxix.

1918 . . . . . Note on some fossil mammals from Salonica and Imbros. *Geol. Mag.* (6), V, pp. 540-543, 1 text-fig.

Arambourg C. and Piveteau J.

1929 . . . . . Les Vertébrés du Pontien de Salonique. *Ann. Paléont. Paris*, XVIII, pp. 59-139, Pls. i-xii.

Baker, W. E.

1835 . . . . . Selected specimens of the Sub-Himalayan fossils in the Dadupur collection. *Journ. As. Soc. Beng.*, IV, pp. 565-570.

Baker, W. E. and Durand, H. M.

1836 . . . . . Fossil remains of the smaller Carnivora from the Sub-Himalayas. *Journ. As. Soc. Beng.*, V, pp. 579-584, Pl. xxvii.

Bardenfleth, K. S.

1913 . . . . . On the systematic position of Aeluropus melanoleucus. Mindeskr. f. Japetus Steenstrup. Copenhagen, Art. xvii, pp. 1-15, Pl. i, 3 text-figs.

Biedermann, W. G. A.

1863 . . . . . Petrefacten aus der Umgegend von Winterthur. part II. Die Braunkohlen von Elgg, pp. 23, Pls. i-v. 4to. Winterthur.

1868 . . . . . *Ibid*, part III, pp. 12, Pls. i-iv.

Blainville, H. M. Ducrotay De

1841 . . . . . Ostéographie des Mammiferes recents et fossiles. Folio Paris, Vol. II, Carnassiers.

Borissiak, A.

1915 . . . . . Mammifères fossiles de Sebastopol. part II. *Mem. Comité Géologique Leningrad*, Nouvelle serie, livr. 137, pp. 1-47, Pls. i-iii.

Bose, P. N.

1880 . . . . . On undescribed fossil Carnivora from the Sivalik Hills. *Quart. Journ. Geol. Soc. London*, XXXVI, pp. 119-136, Pl. vi.

Boule, M.

1893 . . . . . Description de l'Hyæna brevirostris du Pliocène de Sainzelles près le Puy (Haute Loire). *Ann. Sci. Nat. (Zool.)*, (8), XV, pp. 85-97, Pl. i, figs. 1-3.

1901 . . . . . Révision des espèces européenes de Machairodus. *Bull. Soc. Géol. France*, (4), I, pp. 551-573, 17 text-figs.

Campana, D. del.

1913 . . . . . I Cani pliocenici di Toscana. *Pal. Ital. Pisa*, XIX, pp. 189-254, Pls. xiii-xxii.

1914 . . . . . La Lycyæna lunensis n. sp. dell' ossario pliocenico di Olivola. *Op. cit.*, XX, pp. 87-104, Pl. xi, 5 text-figs.

1915-16. . . . Nuove ricerche sui Felini del Pliocene italiano. *Op. cit.*, XXI, pp. 233-291, Pls. xxiii-xxvi and XXII, pp. 1-33, Pls. i-iv.

Carlsson, A.

1905 . . . . . Ist Otocyon caffer die Ausgangsform des Hundegeschlechts oder nicht? *Zool. Jahrb. Syst.*, XXII, pp. 717-754.

Cook, Harold J. . . . *See* Matthew, W. D. & Cook, Harold J.

Cooper, C. F.

1923 . . . . . Carnivora from the Dera Bugti Deposits of Baluchistan. *Ann. Mag. Nat. Hist.* London, (9), XII, pp. 259-263, 4 text-figs.

Cope, E. D.

1880 . . . . . On the extinct Cats of America. *Amer. Nat.*, pp. 833-858, 15 text-figs.

1883 . . . . . The Vertebrata of the Tertiary Formations of the West. *Report U. S. Geol. Surv. Terr.*, III, pp. 1-1009, Pls. i-lxxv.

Croizet, Abbé J. B. and Jobert, A. C. G.

1826-28 . . . . Recherches sur les Ossements fossiles du Department Puy-de-Dome, pp. 1-224, 26 Pls. 4to. Paris.

Dames, W.

1883 . . . . . Über das Vorkommen von Hyænarctos in den Pliocän-Ablagerungen von Pikermi. *Sitzber. Ges. naturf. Freunde*, Berlin, no. 8, pp. 132-139.

Dawkins, W. Boyd

1888 . . . . . On Ailurus anglicus, a new Carnivore from the Red Crag. *Quart. Journ. Geol. Soc. London,* XLIV, pp. 228-231, Pl. x.

Depéret, C. J. J.

1887 . . . . . Recherches sur la succession des faunes de Vertebrés Miocénes de la Vallée du Rhone. *Arch. Mus. Hist. Nat. Lyon,* IV, pp. 45-313, Pls. xii-xxv.

1892 . . . . . La faune de Mammiféres de la Grive-Saint Alban (Isére). *Op. cit.,* V, pp. 1-93, Pls. i-iv.

Depéret, C. J. J. and Rérolle, L.

1885 . . . . . Note sur la géologie et sur les Mammiféres fossiles du bassin lacustre de la Cerdagne. *Bull. Soc. Gèol. France,* (3), XIII, pp. 488-506, map and Pls. xvii-xviii.

Depéret, C. and Llueca, G.

1928 . . . . . Sur l'Indarctos arctoides et la phylogénie des Ursidés. *Bull. Soc. Géol. France,* (4), XXVIII, pp. 149-160, Pls. ix, x.

Dietrich, W. O.

1927 . . . . . Ueber einen Schädel von Ictitherium. *Neues Jahrb. Min., etc., Abhandl.*, LVII, Beil-bd. Abt. B, pp. 364-371, Pl. xxii.

Fabrini, E.

1890 . . . . I Machairodus del Valdarno superiore. *Boll. Com. Geol. Ital.*, XXI, pp. 121-144 ; 161-177, Pls. iv-vi.

Falconer, H.

1868 . . . . Palæontological Memoirs, edited by Murchison, C., Vol. I, pp. 1-590, Pls. i-xxxiv, Vol. II, pp. 1-675, Pls. i-xxxviii. 8vo. London.

Falconer, H. and Cautley, T. P.

1835 . . . . Synopsis of fossil genera and species from the upper deposits of the Tertiary strata of the Sewalik Hills. *Journ. As. Soc. Bengal*, IV, pp. 706-707.

1836 . . . . On Felis cristata, a new fossil tiger from the Sewalik Hills. *As. Research*, XIX, pp. 135-142, Pl. xxi.

1836 . . . . On Ursus sivalensis, a new fossil bear from the Sewalik Hills, *Ibid.*, pp. 193-200.

1846-49 . . . Fauna Antiqua Sivalensis, 125 Pls. folio London.

Falconer, H. and Walker, H.

1859 . . . . Catalogue of fossil vertebrata in the Museum of the Asiatic Society of Bengal, pp. 1-261. 8vo. Calcutta.

Filhol, H.

1876-77 . . . Récherches sur les phosphorites du Quercy. *Ann. Sci. Geol.*, VII and VIII, pp. 1-561, 54 Pls.

1881 . . . . Observations sur le genre Proailurus. *Mem. Soc. Sci. Phys. Nat. Toulouse*, pp. 248-293, Pls. i-v.

1889 . . . . Description d'une espèce nouvelle de Viverra fossile. *Bull. Soc. Phil. Paris*, (8), II, pp. 139-142.

1891 . . . . Études sur les Mammifères fossiles de Sansan. *Ann. Sci. Géol.*, XXI, pp. 1-319, Pls. i-xlvi, 2 text-figs.

Flower, W. H.

1869 . . . . On the value of the characters of the base of the cranium in the classification of the order Carnivora, etc. *Proc. Zool. Soc. London*, 1869, pp. 4-37, 15 figs.

1883 . . . . Article on Mammalia, Encyclopædia Britannica, (9), XV, pp. 347-446, 123 text-figs.

Flower, W. H. and Lydekker, R.

1891 . . . . Mammals living and extinct, pp. xvi+763, 357 text-figs. 8vo. London.

Freudenberg, W.

1910 . . . . Die Säugetier fauna des Pliocäns und Postpliocäns von Mexico; Carnivoren. *Geol. Pal. Abh. Jena*, (2), IX, pp. 196-231, Pls. xx-xxviii.

Frick, Childs.

1926 . . . . The Hemicyoninæ and an American Tertiary Bear. *Bull. Amer. Mus. Nat. Hist.*, LVI, pp. 1-119, frontispiece and 63 text-figs.

Gaillard, C.

1899 . . . . Mammifères Miocènes nouveaux ou peu connus de La Grive St. Alban (Isère). *Arch. Mus. Hist. Nat. Lyon.*, VII, pp. 1-79, Pls. i-iii, 32 text-figs.

Gaudry, Albert

1861 . . . . Note sur les carnassiers fossiles de Pikermi (Grèce). *Bull. Soc. Geol. France*, (2), XVIII, pp. 527-538, Pls. x-xi.

Gaudry, Albert

1862-63 Animaux fossiles et Géologie de l'Attique. **Carnivores, pp. 37-120, Pls. vi-xvii. 4to. Paris.**

The dates of publication of the various parts of this work are stated in Pilgrim and Hopwood 'The Pontian Bovidæ of Europe. *Br. Mus. Cat.* 1928.

1873 Animaux fossiles du Mont Léberon. pp., 180, 21 Pls. 4to. Paris.

Gervais, P.

1848-52 Zoologie et Paléontologie Francaises. pp. viii + 271, 80 Pls., 1st ed. 4to. Paris.

1859 *Idem,* 2nd ed., pp. 1-544, 84 Pls.

Gray, J. E.

1865 Revision of the Genera and Species of Mustelidæ. *Proc. Zool. Soc. London,* 1865, pp. 100-154, Pl. vii, 3 text-figs.

1867 Notes on the skulls of the Cats (*Felidæ*). *Op. cit.,* 1867, pp. 258-77, 7 text-figs.

1868 Notes on the skulls of the species of Dogs, Wolves and Foxes (*Canidæ*) in the collection of the British Museum. *Op. cit.,* 1868, pp. 492-525, 7 text-figs.

Helbing, H.

1917 Zur Kenntnis einiger Carnivoren aus den Phryganidenkalken des Allierbeckens. *Verh. Naturf. Ges.* Basel, XXVIII, pp. 439-461, 12 text-figs.

1925 Das Genus Hyænælurus. *Eclogæ geologicæ Helvetiæ,* XIX, pp. 214-245, Pl. vi, 12 text-figs.

1928 Carnivoren des Oberen Stampien. *Abh. Schweiz. Pal. Ges.*, XLVII, pp. 1-84, Pls. i-iv, 61 text-figs.

See also Stehlin, H. G. and Helbing, H.

Hensel, R.

1862 Über die Reste einiger Säugethierarten von Pikermi in der Münchener Sammlung. *Monatsber k. Preuss. Akad. Wiss. Berlin* Sitz. Aug. 14, pp. 560-69, 1 Pl.

Hofmann, A.

1887 Über einige Säugethierreste aus der Braunkohle von Voitsberg und, Steiregg bei Wies, Steiermark. *Jahrb. k. k. Geol. Reichs.,* XXXVII, pp. 207-218, Pls. x-xii.

1893 Die Fauna von Goriach. *Abh. Geol. Reichsanst.* Wien, XV, pp. 1-87, Pls. i-xvii, 1 text-fig.

Huxley, T. H.

1880 On the cranial and dental characters of the Canidæ. *Proc. Zool. Soc. London,* pp. 238-288, 16 text-figs.

Jäger, G. F.

1835 Über die fossilen Säugethiere welche in Wurttemberg aufgefunden werden sind, pp. 1-70, Pls. i-ix, Folio Stuttgart.

1839 *Idem,* 2nd ed., pp. 1-214, Pls. i-xx, Folio Stuttgart.

Kampen, P. N. Van.

1905 Die Tympanalgegend des Säugetierschädels. *Morphol. Jahrb., Leipzig,* XXXIV, pp. 321-722, 96 text-figs.

Kaup, J. J.

1832-35 . . . . Description d'ossements fossiles de Mammiféres inconnus jusqu'à présent qui se trouvent au Muséum grand-ducal de Darmstadt, pp. 1-16, 1-89, 4to. 26 Pls. folio Darmstadt.

1861 . . . . Beiträge zur naheren Kenntniss der urweltlichen Säugethiere, part 5, 32 pp., Pls. i-vi, 4to. Darmstadt.

Khomenko, J.

1914 . . . . La Faune Méotique du village Taraklia du district de Bendery. *Trav. Soc. Nat. Bessarabia,* V, pp. 1-55, Pls. i-iv, (Russian ; French summary).

Kittl, E.

1887 . . . . Beiträge zur Kenntnis der fossilen Säugethiere von Maragha in Persien I. Carnivoren. *Ann. Naturhist. Hofmus. Wien,* II, pp. 317-338, Pls. xiv-xviii.

Koken, E.

1885 . . . . Über fossile Säugethiere aus China. *Paläontol. Abh., Berlin,* III, heft. 2, pp. 31-114, Pls. vi-xii.

Kormos, T.

1911 . . . . Der Pliozäne Knochenfund bei Polgardi. *Foldtani Kozlony, Budapest,* XLI, pp. 171-189.

Kretzoi, N.

1929 . . . . Materialen zur phylogenetischen Klassification der Aeluroideen. *Proc. Internat. Congr. Zool.* Budapest, 1927, pp. 1293-1355, Pls. xliii-xliv.

1929 . . . . Feliden Studien. *Mag. Kir. Foldt. Int. Haziny. Budapest,* V, 24, pp. 1-22, 9 text-figs.

Lankester, E. Ray and Lydekker, R.

1901 . . . . On the affinities of Aeluropus melanoleucus Milne-Edwards. *Trans. Linn. Soc. London,* (2), VIII Zoology, pp. 162-172, Pls. xviii-xx, 1 text-fig.

Leche, W.

1915 . . . . Zur Frage nach der stammesgeschichtlichen Bedeutung des Milchgebisses bei den Säugetieren II. *Zool. Jahrb. Abt. System., Geogr. & Biol. Jena,* XXXVIII, pp. 275-370.

Lydekker, R.

1876 . . . . Molar teeth and other remains of Mammalia. *Pal. Ind.,* (10), I, pp. 19-87, Pls. iv-vii.

1877 Notices of new and other Vertebrata, etc. *Rec. Geol. Surv. Ind.,* X, pp. 30-43 ; 76-83.

1878 . . . . Notices of Siwalik Mammals. *Op. cit.,* XI, pp. 64-104.

1881 . . . . Note on some Siwalik Carnivora. *Op. cit.,* XIV, pp. 57-66.

1882 . . . . Note on some Siwalik and Jamna Mammals. *Op. cit.,* XV, pp. 28-33.

1884 . . . . Siwalik and Narbada Carnivora. *Pal. Ind.,* (10), II, pp. 178-351, Pls. xxvi-xlv, 21 text-figs.

1885 . . . . Catalogue of Fossil Mammalia in the British Museum (Natural History), part i, pp. xxx+268, 33 text-figs. 8vo. London.

1886 . . . . The Fauna of the Karnul caves. *Pal. Ind.,* (10), IV, pp. 23-58, Pls. vii-xi.

1888 . . . . Notes on Indian fossil Vertebrata ; the ulna of Hyænarctos. *Rec. Geol. Surv. Ind.,* XXI, pp. 145-146, 2 text-figs.

Lydekker, R.

1890 . . . . . On a new species of otter from the lower Pliocene of Eppelsheim. *Proc. Zool. Soc. London*, 1890, pp. 3-5, text-fig.

1891 . . . . . *See* Flower, W. H. and Lydekker, R.

1901 . . . . . *See* Lankester, E. Ray and Lydekker, R.

Major, C. I. Forsyth.

Considerazioni sulla Fauna del Mammiferi pliocenicie post-pliocenici della Toscana. *Atti. Soc. Tose. Sci. Nat.*, III, pp. 207, Pls. xiii, xiv.

1902 . . . . . On Mustela palaeattica from the Upper Miocene of Pikermi and Samos. *Proc. Zool. Soc. London*, 1902, pp. 109-114, Pl. vii.

1903 . . . . . New Carnivora from the Middle Miocene of La Grive-Saint Alban, Isére, France. *Geol. Mag.*, (4), X, pp. 534-537.

Martelli, A.

1906 . . . . . Su due Mustelidi e un Felide del pliocene Toscana. *Boll. Soc. Geol., Ital.*, XXV, pp. 595-612, Pl. viii.

Matthew, W. D.

1901 . . . . . Fossil Mammals of the Tertiary of North Eastern Colorado. *Mem. Amer. Mus. Nat. Hist.*, I, pt. 7, pp. 355-447, Pls. xxxvii-xxxix, 34 text-figs.

1902 . . . . . A skull of Dinocyon from the Miocene of Taxas. *Bull. Amer. Mus. Nat. Hist.*, XVI, pp. 129-136, 4 text-figs.

1902 . . . . . On the skull of Bunælurus. *Op. cit.*, pp. 137-140, 3 text-figs.

1902 . . . . . New Canidæ from the Micocene of Colorade. *Op. cit.*, XVI, pp. 281-290, 4 text-figs.

1907 . . . . . A lower Miocene fauna from South Dakota. *Op. cit.*, XXIII, pp. 169-219, 26 text-figs.

1910 . . . . . The phylogeny of the Felidæ. *Op. cit.*, XXVIII, pp. 289-316, 15 text-figs.

1918 . . . . . Contributions to the Snake Creek Fauna. *Op. cit.*, XXXVIII, pp. 183-229, Pls. iv-x, 20 text-figs.

1923 . . . . . Correlation of the Tertiary formations of the Great Plains. *Bull. Geol. Soc. Amer.*, XXXV, (1924), pp. 743-754.

1924 . . . . . Third contribution to the Snake Creek Fauna. *Bull. Amer. Mus. Nat. Hist.*, L, pp. 59-210, 63 text-figs.

1929 . . . . . Critical observations upon Siwalik Mammals. *Op. cit.*, LVI, pp. 437-560, 55 text-figs.

See also Wortman, J. L. and Matthew, W. D.

Matthew, W. D. and Gidley, J. W.

1904 . . . . . New or little known Mammals from the Miocene of South Dakota. *Bull. Amer. Mus. Nat. Hist.*, XX, pp. 241-268, 15 text-figs.

Matthew, W. D. and Cook, Harold J.

1909 . . . . . A Pliocene fauna from Western Nebrasca. *Bull. Amer. Mus. Nat. Hist.*, XXVI, pp. 361-414, 27 text-figs.

Mayet, L.

1908 . . . . Étude des Mammifères miocènes des Sables de l'Orléanais et des Faluns de la Touraine. *Ann. Univ. Lyon, n.s er.*, Fasc. 24, pp. 1-336, Pls. i-xii, 100 text-figs.

Mecquenem, R. De

1925 . . . . Contribution à l'étude des fossiles de Maragha, part 2. *Ann. Pal.* Paris, XIV, pp. 1-36, Pls. v-ix, 7 text-figs.

Meneghini, Giuseppe.

1863 . . . . Descrizione dei resti di due fiere trovati nelli Ligniti Mioceniche de Monte Bamboli. *Atti. Soc. Ital. Sci. Nat.*, IV, pp. 17-58, Pls. i-ii.

Merriam, J. C.

1919 . . . . Tertiary Mammalian faunas of the Mohave Desert. *Univ. Cal. Publ. Bull. Dept. Geol.*, XI, pp. 437-585, 253 text-figs.

Merriam, J. C., Stock, Chester and Moody, C. L.

1916 . . . . An American, Pliocene bear. *Univ. Cal. Publ. Bull. Dep. Geol.*, X, pp. 87-109, 23 text-figs.

Meyer, H. von

1837 . . . . Mittheilung über die fossilen knochen im Besitz der Fürstlich Fürstenbergischen Sammlung in Donaueschingen. *Neu. Jahrb. Min. Geol. Pal.*, 1837, p. 675.

1838 . . . . *Idem, Neu. Jahrb. Min. Geol. Pal.*, 1838, p. 413.

Miller, G. S.

1912 . . . . Catalogue of the mammals of Western Europe in the collection of the British Museum. *Br. Mus. Cat.*, pp. i-xvi, 1-1019, 213 text-figs.

1927 . . . . Revised determinations of some Tertiary Mammals from Mongolia. *Pal. Sinica*, Ser. C. V. fasc. 2, pp. 5-20.

Mivart, St. G.

1881 . . . . The Cat., pp. xxiii+557, frontispiece and 209 text-figs. 8vo. London.

1882 . . . . On the classification and distribution of the Aeluroidea. *Proc. Zool. Soc. Lond.*, 1882, pp. 135-208.

1890 . . . . Notes on the South American Canidæ *Op. cit.*, 1890, pp. 98-113, 8 text-figs.

1890 . . . . Dogs, Jackals, Wolves and Foxes: A Monograph on the Canidæ, pp. xxxvi + 216, Pls. i-xlv, 57 text-figs., large 8vo. London.

Newton, E. T.

1890 . . . . On some new Mammals from the Red and Norwich Crags. *Quart. Journ. Geol. Soc. London*, XLVI, pp. 444-453, Pl. xviii.

Nordmann, A. von.

1858 . . . . Palæontologie Sud-Russlands. pp. 1-360, 4to., Pls. i-xxviii folio, Helsingfors.

Owen, R.

1840-45 . . . Odontography, 2 vols., pp. i-lxxiv, 1-655, Pls. i-cl. 8vo. London.

1870 . . . . On fossil remains of Mammals found in China. *Quart. Journ. Geol. Soc. London*, XXVI, pp. 417-434, Pls. xxvii-xxix.

Pavlow, M.

1908 . . . . Quelques Carnivores Fossiles du gouvernement de Kherson et de Bessarabie. *Mem. Soc. Nat. Nouvelle-Russie, Odessa*, XXXII, pp. 27-48, Pls. i, ii.

1914 . . . . Mammifères Tertiaires de la nouvelle Russie, part II. *Nouv. Mem. Soc. Nat. Moscou.*, XVII, livr. 4, pp. 1-52, Pls. v-vii, 4 text-figs.

Peterson, O. A.

1906 . . . . The Miocene beds of Western Nebrasca and Eastern Wyoming and their Vertebrate fauna. *Ann. Carn. Mus.*, IV, No. 1, pp. 21-72, Pls. ix-xix, 20 text figs.

1910 . . . . Description of New Carnivores from the Miocene of Western Nebrasca. *Ibid.*, No. 5, pp. 205-278, Pls. lxxiv-lxxxv, 69 text figs.

Pilgrim, G. E.

1910 . . . . Preliminary Note on a Revised classification of the Tertiary Freshwater Deposits of India. *Rec. Geol. Surv. Ind.*, XL, pp. 185-205.

1911 . . . . Vertebrate fauna of the Gaj series in the Bugti Hills and the Punjab. *Pal. Ind.* new ser., IV, No. 2, pp. 1-83, Pls. i-xxxi.

1910 . . . . Notices of new Mammalian genera and species from the Tertiaries of India. *Rec. Geol. Surv. Ind.*, XL, pp. 63-71.

1913 . . . . Correlation of the Siwaliks with Mammal horizons of Europe. *Op. cit.*, XLIII, pp. 264-326.

1914 . . . . Further description of Indarctos salmontanus Pilgrim, etc. *Cp. cit.*, XLIV, pp. 225-233, Pl. xx.

Description of teeth referable to the Lower Siwalik Creodont genus Dissopsalis. *Ibid.*, pp. 265-279, Pl. xxix, 2 text figs.

1915 . . . . Note on the new feline genera Sivælurus and Paramachœrodus, etc. *Op. cit.*, XLV, pp. 138-155, Pls. v, vi.

1925 . . . . The Migration of Indian Mammals. *Proc. 12th Indian Sci. Cong.*, pp. 200-218.

1926 . . . . The Tertiary formations of India and the interrelation of the marine and terrestrial deposits. *Proc. Pan-Pacific Sci. Cong.* 1923, pp. 896-931, 3 figs.

1931 . . . . Catalogue of the Pontian Carnivora of Europe in the British Museum *Br. Mus. Cat.* p. 174, Pls. i, ii, 30 text figs.

Piveteau, J. . . . . *See* Arambourg, C. and Piveteau, J.

Pocock, R. I.

1915 . . . . On the feet and glands and other external characters of the Viverrinæ with the description of a new genus. *Proc. Zool. Soc. London*, 1915, pp. 131-149.

1916 . . . . On some of the external structural characters of the Striped Hyæna (*Hyaena hyaena*) and related genera and species. *Ann. Mag. Nat, Hist.*, XVII, pp. 330-343, 5 figs.

The tympanic bulla in Hyænas. *Proc. Zool. Soc. London*, 1916, pp. 303-307, 2 figs.

The alisphenoid canal in Civets and Hyænas. *Ibid.*, pp. 442-445, 2 text figs.

On some of the external characters of Cryptoprocta. *Ann. Mag. Nat. Hist.*, (8), XVII, pp. 413-425, 4 text figs.

1920 . . . . On the external characters of the Ratel (*Mellivora*) and the Wolverene (*Gulo*). *Proc. Zool. Soc. London*, 1920, pp. 179-187, 5 text figs.

On the external and cranial characters of the European Badger (*Meles*) and of the American Badger (*Taxidea*). *Ibid.*, pp. 423-436, 7 text figs.

Pocock, R. I.
1921 . . . . The external characters and classification of the Procyonidæ. *Proc. Zool. Soc. London*, 1921, pp. 389-422, 13 text figs.
The auditory bulla and other crania characters in the Mustelidæ. *Op. cit.*, pp. 472-486, 5 text figs.
On the external characters and classification of the Mustelidæ. *Op. cit.*, pp. 803-837, 13 text figs.
1929 . . . . Tigers. *Journ. Bomb. Nat. Hist. Soc.*, XXXIII, pp. 505-541, 13 Pls.
1930 . . . . The Panthers and Ounces of Asia. *Journ. Bomb. Nat. Hist. Soc.*, XXXIV, pp. 64-82, 307-336, 13 Pls.

Pohle, H.
1919 . . . . Die Unterfamilie der Lutrinæ. *Arch. Naturges. Berlin*, LXXXV, Abt. A, heft 9, pp. 1-247, Pls. i-x, 19 text figs.
1928 . . . . Die Raubtiere von Oldoway. Wissenschaftliche Ergebnisse der Oldoway Expedition 1913, Neue Folge, heft 3, pp. 45-54, Pls. iii-v.

Pomel, A.
1853 . . . . Catalogue Méthodique et descriptif des vertébrés fossiles, etc., pp. 1-193, 8vo. Paris.

Rerolle, L. . . . *See* Depéret, C. and Rerolle, L.

Roger, O.
1896 . . . . Verzeichniss der bisher bekannten fossilen Säugethiere, pp. 1-272, 8vo. Augusburg.

Roth, J. & Wagner, A.
1855 . . . . Die fossilen Knochenüberreste von Pikermi. *Abh. bayer. Akad Wiss.*, VII, pp. 373-464, Pls. vii-xiv.

Schaub, S.
1925 . . . . Über die Osteologie von *Machærodus cultridens*, Cuv. *Eclogæ geologicæ Helvetiæ*, XIX, pp. 255-266, 4 text figs.

Schlesinger, G.
1912 . . . Studien über die Stammesgeschichte der Proboscidier. *Jahrb. Geol. Reichs. Anst. Wien.*, LXII, pp. 87-182, Pls. vi-vii, 10 text figs.

Schlosser, Max.
1887-90 . . . Die Affen, Lemuren. Cheiropteren, etc. *Beitr. Pal. Oest.-Ung.*, VI-VIII, pp. 1-492, Pls. i-ix.
1899 . . . . *Parailurus anglicus* und *Ursus böckhi* aus den Ligniten von Baroth-Kopecz. *Mitt. Jahrb. k. Ung. Geol. Anst.*, XIII, pp. 67-95, Pls. x-xii.
1899 . . . . Über die Bären und Bärenähnlichen Formen des Europäischen Tertiärs. *Palæontographica*, XLVI, pp. 95-147, Pls. xiii, xiv, 1 text fig.
1902 . . . . Beiträge zur Kenntniss der Säugethiereste aus den süddeutschen Bohnerzen. *Geol. u. Pal. Abh.* new ser. V, pp. 117-258, Pls. i-v.
1903 . . . . Die fossilen Säugethiere Chinas. *Abh. bayer. Akad. Wiss.*, XXII, pp. 1-221, Pls. i-xiv, 32 text figs.
1916 . . . . Neue Funde fossiler Säugetiere in der Eichstätter Gegend. *Op. cit.*, XXVIII, Abh. 6, pp. 1-78, Pls. i-vi.
1921 . . . . Die Hipparionenfauna von Veles in Mazedonien. *Op. cit.*, XXIX, Abh. 4, pp. 1-55, Pls. i, ii.

Schlosser, Max.

1923 . . . . . *See* Zittel, K. A. von.

1924 . . . . . Tertiary Vertebrates from Mongolia. *Palæont. Sinica.* ser. C, I, fasc. 1, pp. 1-119, Pls. i-vi, 5 text figs.

Schwarz, E.

1912 . . . . . Über einen Schädel von *Palhyaena hipparionum,* Gerv. *Arch. Natugesch. Berlin,* LXXVIII, A, pp. 69-75, Pls. i-iii.

Sinclair, W. J.

1915 . . . . . Additions to the fauna of the Lower Pliocene Snake Creek beds. *Proc. Amer. Phil. Soc.,* LIV, pp. 73-95, 18 text figs.

Stehlin, H. G.

1907 . . . . . Notices paléomammalogiques sur quelques dépôts miocènes des bassins de la Loire et de l'Allier. *Bull. Soc. Geol. France* (4) VII, pp. 525-550, 3, text figs.

1917 . . . . . Miocäne Säugetierreste aus der Gegend von Elm (Prov. Hessen), *Verh. Naturf. Ges. Basel,* XXVII, pp. 191-205, 7 text figs.

and Helbing, H.

1925 . . . . . Catalogue des ossements de Mammifères Tertiaires de la Collection Bourgeois à l'école de Pont-Levoy. *Bull. Soc. Hist. Nat. et Anthr. de Loir et Cher* No. 18, pp. 77-277, 31 text figs.

Stock, Chester . . . *See* Merriam, J. C., Stock, Bhester and Moody, C. L.

Stromer, E.

1920 . . . . . Mitteilungen über Wirbeltierreste aus dem Mittelpliocän des Natrontales (Ägypten). *Sitzber. bayer. Akad. Wiss. Münchan,* 1920, pp. 345-370, plate.

1931 . . . . . Reste Süsswasser und Land bewohnender Wirbeltiere aus den Diamantfeldern Klein-Namaqualandes (Südwestafrika) *Soc. cit.,* 1931, pp. 17-47, Pls. i, ii.

Suess, E.

1861 . . . . . Über die grossen Raubthiere der österreichischen Tertiär-ablagerungen. *Sitzber. Akad. Wiss. Wien.,* XLIII, abt. 1, pp. 217-232, Pls. i, ii.

Teilhard de Chardin, P.

1915 . . . . . Les Carnassiers des Phosphorites du Quercy. *Ann. Pal. Paris,* IX, pp. 103-191, Pls. xii-xx, 13 text figs.

1926 . . . . . Description des Mammifères Tertiaires de Chine et de Mongolie. *Ann. Pal. Paris,* XV, pp. 1-51, Pls. i-v, 25 text figs.

Thomas, Oldfield

1889 . . . . . On the different species of otter. *Proc. Zool. Soc. London,* 1889, pp. 190-200.

Trouessart, E. L.

1897-99 . . . . Catalogus Mammalium tam viventium quam fossilium, pp. i-vi, 1-1469, 8vo. Berlin.

1904-5 . . . . . Catalogus Mammalium, etc., Supplement, pp. i-vii, 1-929, 8vo. Berlin.

Vaughan, T. W.

1923 . . . . . Criteria and Status of correlation and classification of Tertiary deposits. *Bull. Geol. Soc. Amer.,* XXXV (1924), pp. 677-742.

Viret, J.

1929 . . . . . Les faunes de Mammifères de l'Oligocène supérieur de la Limagne Bourbonnaise. *Ann. Univ. Lyon,* fasc. 47, pp. 1-328, Pls. i-xxxi, 32 text figs.

1929 . . . . . *Cephalogale batalleri,* Carnassier du Pontien de Catalogue, *Bull, Soc. Hist. Nat. Toulouse,* LVIII, pp. 565-68, Pl. viii.

Wagner, A.

1837 . . . . Paläontologische Abhandlungen. *Gelehrte Anzeigen bayer. Akad. Wiss. München*, pp. 334-335.

1840 . . . . Fossile Überreste von einem Affen und einigen andern Säugetieren aus Griechenland. *Abh. bayer. Akad. Wiss.*, III, pp. 153-170, Pl. i.

1857 . . . . Neue Beiträge zur Kenntnis der fossilen Säugethierreste von Pikermi. *Abh. bayer. Akad. Wiss.*, VIII, pp. 111-158, Pls. iii-ix.

See also Roth, J. and Wagner, A.

Weber, Max

1928 . . . . Die Säugethiere, Vol. II in collaboration with O. Abel, pp. xxiv+898, 573 text figs. 8vo. Jena.

Wegner, R. N.

1913 . . . . Tertiär und umgelagerte Kreide bei Oppeln. *Palæontographica*, LX, pp. 175-274, Pls. ix-xv, 35 text figs.

Weithofer, A.

1888 . . . . Beiträge zur Kenntniss der Fauna von Pikermi. *Beitr. Pal. Österr.-Ungarns.*, VI, pp. 225-292, Pls. x-xix.

1889 . . . . Die fossilen Hyänen des Arnothales. *Denkschr. Akad. Wiss. Wien.* LV, pp. 337-360, Pls. i-iv.

Ueber die tretiären Landsäugethiere Italiens. *Jahnb. k. k. geol. Reichs,, Ulien,* XXXIX, pp. 55-82.

Winge, H.

1895 . . . . Jordfundne og nulevende Rovdyr (Carnivora) fra Lagoa Santa Minas Geraes, Brasilien. Mus. Lundii Afh. Copenhagen, II, pt. 4, pp. 3-104, pl. i-viii.

Woodward, A. Smith

1915 . . . . On the skull of an extinct mammal related to Aeluropus, from a cave in the Ruby Mines at Mogok, Burma. *Proc. Zool. Soc. London*, 1915, pp. 425-428, Pls. i, text fig.

Wortman, J. L.

1894 . . . . On the affinities of Leptarctus primus Leidy. *Bull. Amer. Mus. Nat. Hist.*, VI, pp. 229-231.

Wortman, J. L. and Matthew, W. D.

1899 . . . . The ancestry of certain members of the Canidæ, the Viverridæ, and Procyonidæ. *Bull. Amer. Mus. Nat. Hist.*, XII, pp. 109-138, Pl. vi, 10 text figs.

Zdansky, O.

1923 . . . . Fundorte der Hipparion-Fauna um Pao-Te-Hsien in N. W. Shansi. *Bull. Geol. Surv. China*, No. 5, pp. 69-81, Pls. i-v, 4 text figs.

1924 . . . . Jungtertiäre Carnivoren Chinas. *Pal. Sinica* ser. C, II, fasc. 1, pp. 1-149, Pls. i-xxxiii.

1925 . . . . Quartäre Carnivoren aus Nord-China. *Op. cit.*, fasc. 2, pp. 1-28, Pls. i-iv, 2 text figs.

1927 . . Weitere Bemerkungen über fossile Carnivoren aus China. *Op. cit.*, IV, fasc. 4, pp. 1-30, Pls. i-ii.

Zittel, K. A. von

1891-93 . . . Handbuch der Paläontologie, Vol. IV, Mammalia, pp. xi+799, 590 text figs. 810, München and Leipzig.

1923 . . . . Grundzüge der Paläontologie, Mammalia, pp. 402-662, text figs. 505-800, revised by Max Schlosser, 8vo. München and Berlin.

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PLATE I.

FIGS. 1, 1a, 1b. SIVALICTIS NATANS, sp. nov. Right upper M^1, from the Chinji stage of Chinji (G. S. I. no. D. 227); fig. 1, surface view; fig. 1a, view from anterior side; fig. 1b. diagrammatic surface view; *pr.* protocone; *me.* metacone *pa.* paracone. Page 77.

FIGS. 2, 2a. AMPHICYON (cf.) PITHECOPHILUS, sp. nov. Right lower M_3, from the Chinji stage of Chinji (G. S. I. no. D. 228); fig. 2, surface view; fig. 2a, view from inner side Page 17.

FIGS. 3, 3a. AMPHICYON (cf.) PALÆINDICUS, Lyd. Right lower M_3, from the Chinji stage of Chinji (G. S. I. no. D. 229); fig. 3, surface view; fig. 3a, view from inner side. Page 15.

FIGS. 4, 4a. (?) VISHNUCYON CHINJIENSIS, sp. nov. Upper M^3 from the Chinji stage of Chinji (G. S. I. no. D. 230); fig. 4, surface view; fig. 4a, view from the side. Page 27.

FIGS. 5, 5a, 5b, 5c. INCERTÆ SEDIS, gen. indet., sp. indet. Left upper P^4, from the Chinji stage of Chinji (G. S. I. no. D. 128); fig. 5, view from outer side; fig. 5a, view from inner side; fig. 5b, surface view; fig. 5c, diagrammatic surface view; *pr.* protocone; *par.* paracone; *pst.* parastyle; *met.* metacone. Page 79.

FIG. 6. SIVACYON CURVIPALATUS (BOSE). Left mandibular ramus, view from outer side. From the Pinjor stage of the Siwalik Hills, between the Markanda pass and Pinjor (Br. Mus. no. 37149). Page 34.

FIGS. 7, 7a. INCERTÆ SEDIS, gen. indet., sp. indet. Fragmentary left maxilla with P^3, P^2, the canine, and the broken anterior portion of the alveolus of P^4, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 207); fig. 6, view from outer side; fig. 6a, palatal view. Page 80.

FIGS. 8, 8a. INCERTÆ SEDIS, gen. indet., sp. indet. Left mandibular ramus with M_1 and the alveolus of M_2, from the Chinji stage of Chinji (G. S. I. no. D. 240); fig. 8, surface view; fig. 8a, view from outer side.

FIGS. 9, 9a, 9b. AMPHICYON cf. PALÆINDICUS, Lyd. Part of the left ramus of a fragmentary mandible showing M_2 and the root of M_3, from the Chinji stage of Chinji (G. S. I. no. D. 226); fig. 9, surface view; fig. 9a, view from inner side; fig. 9b, view from outer side. Page 16.

FIG. 10. AMPHICYON cf. SHAHBAZI, Pilgrim. Right maxilla with P^4 and alveolus of M^1, surface view from the Gaj series, Bugti stage of Kumbhi, Bugti Hills, Baluchistan (G. S. I. no. D. 108). Page 22.

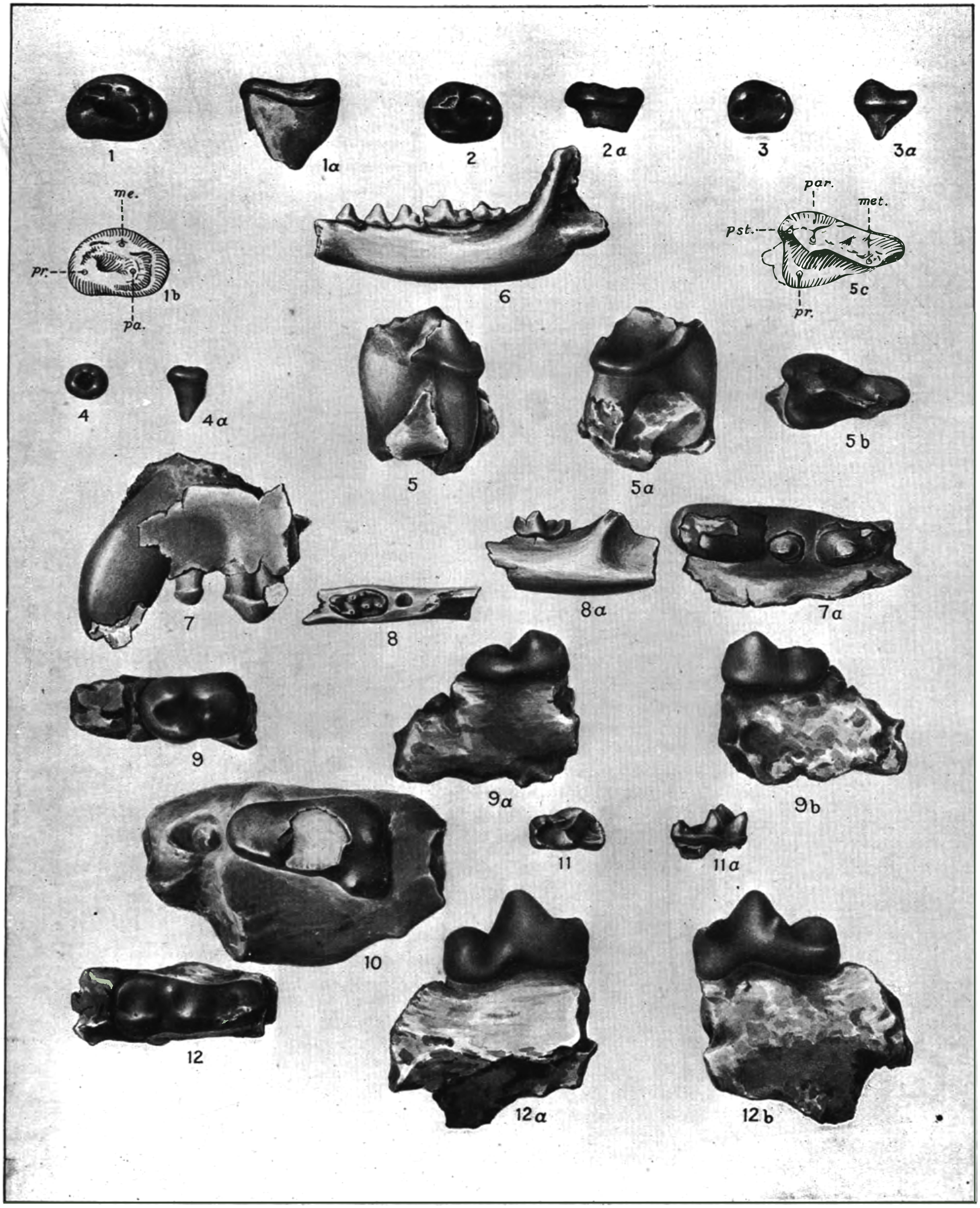
FIGS. 11, 11a. INCERTÆ SEDIS, gen. indet., sp. indet. Left M_1 from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 242); fig. 11, surface view; fig. 11a, view from inner side.

FIGS. 12, 12a, 12b. AMPHICYON cf. PALÆINDICUS, Lyd. Part of the right ramus of the same mandible of which the left ramus is figured in fig. 9, showing M_1 (G. S. I. no. D. 225); fig. 12, surface view; fig. 12a, view from outer side, fig. 12b, view from inner side. Page 16.

All figures natural size.

Indian Fossil Carnivora.

Geol. Surv. of India. Pl. I.



S. N. Guine, *del.*

G. S. I. Calcutta.

PLATE II.

FIGS. 1, 1a. AMPHICYON cf. PITHECOPHILUS, sp. nov. Fragmentary first left lower molar, from the Chinji stage of Chinji (G. S. I. no. D. 131); fig. 1, surface view; fig. 1a, view from inner side. Page 17.

FIGS. 2, 2a. AMPHICYON cf. PITHECOPHILUS, sp. nov. First left upper molar from the Chinji stage of Chinji (G. S. I. no. D. 155); fig. 2, view from outer side; fig. 2a, surface view. Page 18.

FIGS. 3, 3a. AMPHICYON PITHECOPHILUS, sp. nov. Second right upper molar from the Chinji stage of Chinji (G. S. I. no. D. 129); fig. 3, surface view; fig. 3a, view from outer side. Page 18.

FIGS. 4, 4a. AMPHICYON cf. PITHECOPHILUS, sp. nov. Second left lower molar in a fragmentary mandibular ramus from the Chinji stage of Chinji (G. S. I. no. D. 130); fig. 4, surface view; fig. 4a, view from outer side. Page 19.

FIG. 5. AMPHICYON sp. Second left lower molar from the Chinji stage of Chinji (G. S. I. no. D. 132); surface view. Page 24.

FIGS. 6, 6a. AMPHICYON SHAHBAZI, Pilg. First right upper molar from the Gaj horizon of the Bugti Hills (G. S. I. no. D. 113); fig. 6, surface view; fig. 6a, view from outer side. Page 22.

FIG. 7. ARCTAMPHICYON LYDEKKERI, Pilg. First right upper molar from the Dhok Pathan stage of Padhri (G. S. I. no. D. 133), surface view. Page 25.

FIGS. 8, 8a. ARCTAMPHICYON LYDEKKERI, Pilg. Second right upper molar from the Dhok Pathan stage of Padhri (G. S. I. no. D. 134); fig. 8, surface view; fig. 8a, view from outer side. Page 26.

FIGS. 9, 9a, 9b. VISHNUCYON CHINJIENSIS, sp. nov. Left maxilla from the Chinji stage of Chinji (G. S. I. no. D. 127); fig. 9, surface view; fig. 9a, view of P^4 from inner side; fig. 9b, view of the two molars from outer side. Page 27.

FIGS. 10, 10a, 10b. SIVANASUA PALÆINDICA, sp. nov. Last right lower premolar in embryo in a mandibular ramus from the Chinji stage of Chinji (G. S. I. no. D. 224); fig. 10, surface view; fig. 10a, view from outer side; fig. 10b, view from inner side. Enlarged twice natural size. Page 57.

FIGS. 11, 11a, 11b. SIVANASUA PALÆINDICA, sp. nov. First right lower molar in the same mandible as fig. 10; fig. 11, surface view; fig. 11a, view from outer side; fig. 11b, view from inner side. Enlarged twice natural size. Page 56.

FIGS. 12, 12a, 12b. SIVANASUA PALÆINDICA, sp. nov. Second right lower molar in the same mandible as fig. 10; fig. 12, surface view; fig. 12a, view from outer side; fig. 12b, view from inner side. Enlarged twice natural size. Page 57.

FIG. 13. SIVANASUA HIMALAYENSIS, sp. nov. First right lower molar from a fragmentary ramus, from the Nagri stage of Haritalyangar (G. S. I. no. D. 237); surface view. Enlarged twice natural size. Page 59.

FIGS. 14, 14a, 14b. SIVAONYX BATHYGNATHUS (Lyd.). Left mandibular ramus, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 156); fig. 14, surface view; fig. 14a, view from inner side; fig. 14b, view from outer side. Page 89.

FIGS. 15, 15a, 15b. ENHYDRIODON cf. FALCONERI, Pilgrim. First right lower molar from the neighbourhood of Hasnot (G. S. I. no. D. 161); fig. 15, surface view; fig. 15a, view from outer side; fig. 15b, view from inner side. Page 87.

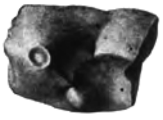
FIGS. 16, 16a. SIVAONYX BATHYGNATHUS (LYD). Last right upper premolar from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 157); fig. 16, surface view; fig. 16a. view from inner side. Page 90.

FIGS. 17, 17a. VISHNUONYX CHINJIENSIS, sp. nov. Last right upper premolar from the Chinji stage of Chinji (G. S. I. no. D. 223); fig. 17, surface view; fig. 17a, view from inner side. Page 94.

FIGS. 18 18a, 18b. LUTRINE, gen. indet., HASNOTI, sp. nov. Right mandibular ramus from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 135); fig. 18, surface view; fig. 18a, view from inner side; fig. 18b, view from outer side. Page 75.

Figures 10-10b, 11-11b, 12-12b, and 13 are twice natural size; the remaining figures are natural size.

Indian Fossil Carnivora.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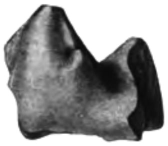
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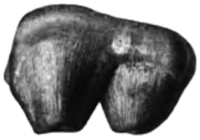
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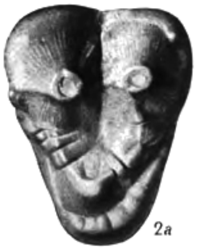
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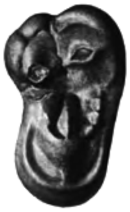
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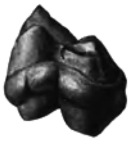
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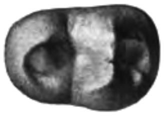
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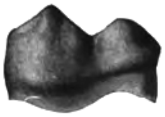
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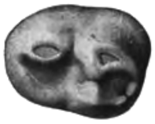
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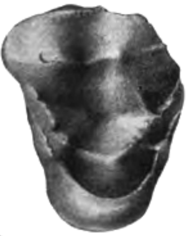
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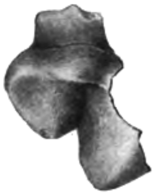
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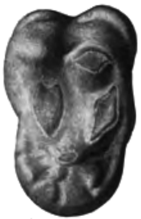
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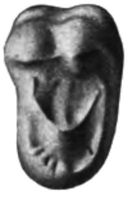
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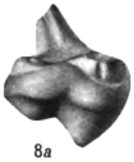
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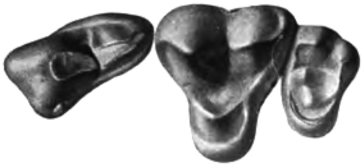
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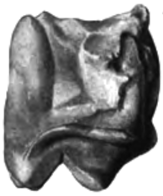
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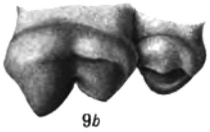
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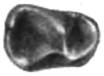
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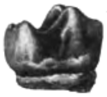
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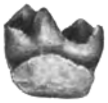
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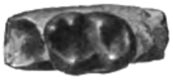
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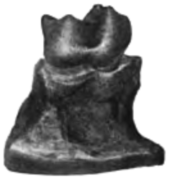
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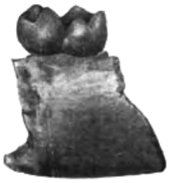
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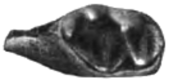
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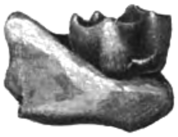
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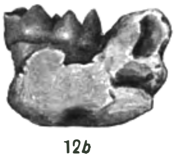
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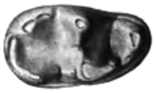
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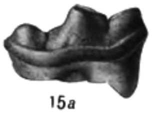
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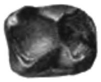
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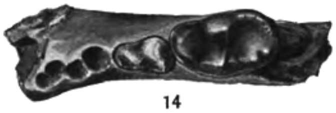
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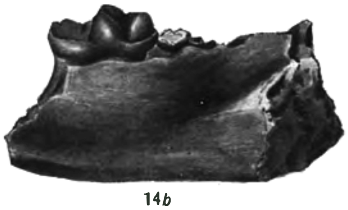
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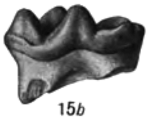
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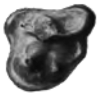
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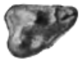
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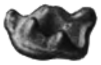
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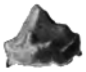
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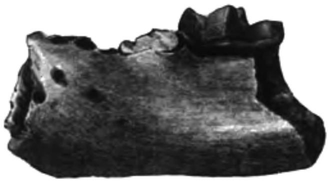
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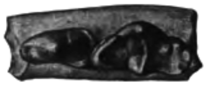
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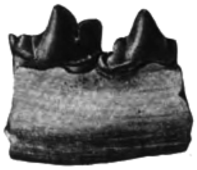
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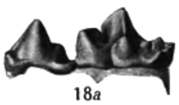
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G. M. Woodward, *del.* figs. 1-5, 7-9 & S. N. Guine, *del.* figs. 6, 10-14. *G. S. I. Calcutta.*

PLATE III.

FIGS. 1, 1a. AMPHICYON cf. SHAHBAZI, Pilg. First left lower molar, from the Lower Murree stage, 3½ miles N. of Basal, Attock district (G. S. I. no. D. 247); fig. 1, surface view; fig. 1a, view from inner side. Page 21.

FIGS. 2, 2a, 2b. SIVAFELIS POTENS, sp. nov. Right mandibular ramus with M_1, P_3, P_2 and the base of the canine, from the Pinjor stage of the Upper Siwalik near Moginand (G. S. I. no. D. 222); fig. 2, view from outer side; fig. 2a, view from inner side; fig. 2b, surface view. Page 200.

FIGS. 3, 3a. EOMELLIVORA (?) sp. Third left upper premolar, from the Chinji stage at Bhilomar near Chinji (G. S. I. no. D. 256a); fig. 3, surface view; fig. 3a, view from inner side. Page 69.

FIGS. 4, 4a. EOMELLIVORA (?) cf. NECROPHILA. A left lower premolar from the same horizon and locality as the preceding specimen (G. S. I. no. D. 255b); fig. 4, view from inner side; fig. 4a, surface view. Page 68.

FIGS. 5, 5a. EOMELLIVORA (?) NECROPHILA, sp. nov. First left lower molar, from the same horizon and locality as the two preceding specimens (G. S. I. no. D. 243); fig. 5, surface view; fig. 5a, view from inner side. Page 68.

FIGS. 6, 6a. EOMELLIVORA (?) sp. A left lower premolar, from the same locality and horizon; as the three preceding specimens (G. S. I. no. D. 256b); fig. 6, view from inner side; fig. 6a, surface view. Page 68.

FIGS. 7, 7a. EOMELLIVORA (?) cf. NECROPHILA, sp. nov. Left mandibular ramus with roots or alveoli of the complete dentition, from the Chinji stage south of Chinji (G. S. I. no. D. 254); fig. 7, view from inner side; fig. 7a, surface view. Page 69.

FIGS. 8, 8a. INCERTAE SEDIS, gen. indet., sp. indet. From the Chinji stage of Chinji.

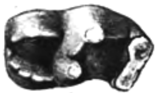
FIG. 9. INDARCTOS cf. SALMONTANUS, Pilg. Left mandibular ramus with M_1 and M_2, surface view. From the Dhok Pathan stage of Hasnot (G. S. I. no. D. 159). Page 44.

FIGS. 10, 10a. (?) SIVAFELIS POTENS, sp. nov. Left maxilla with P^4, from the Upper Siwalik. of Jharakki, Rawalpindi district (G. S. I. no. D. 265); fig. 10, surface view; fig. 10a, view from outer side. Page 201.

FIGS. 11, 11a. LUTRINE, gen. indet. FURTIVUS, sp. nov. Right mandibular ramus showing M_1 and P_4 and the roots or alveoli of $P_{1\text{-}3}$ and M_2 from the (G. S. I. no. D. 239); fig. 11; view from outer side; fig. 11a, surface view. Page 76.

FIGS. 12, 12a, 12b. HYAINAILOUROS LAHIRII, sp. nov. Right mandibular ramus with M_1 and P_4 from the Kamlial stage one mile N.W. of Phamra Khalsa, Attock district (G. S. I. no. D. 236); fig. 12, surface view; fig. 12a, inner view of P_4; fig. 12b, inner view of M., Page 170.

All figures natural size.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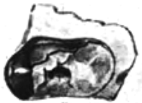
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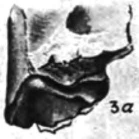
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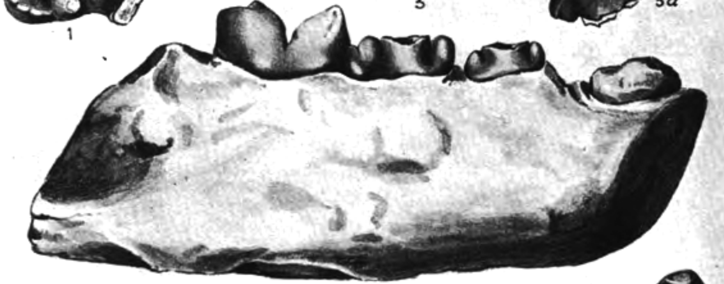
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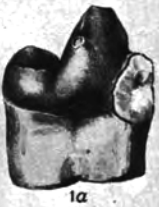
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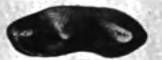
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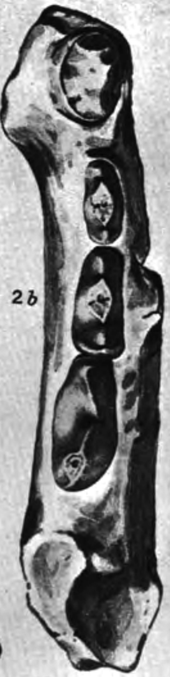
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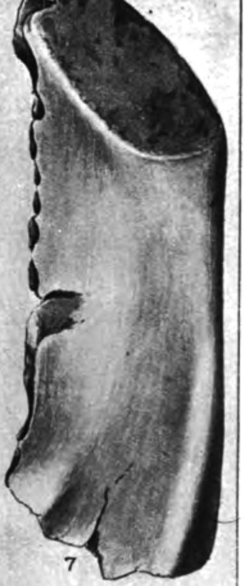
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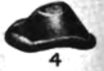
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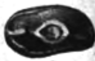
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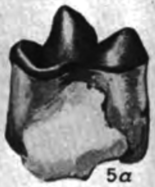
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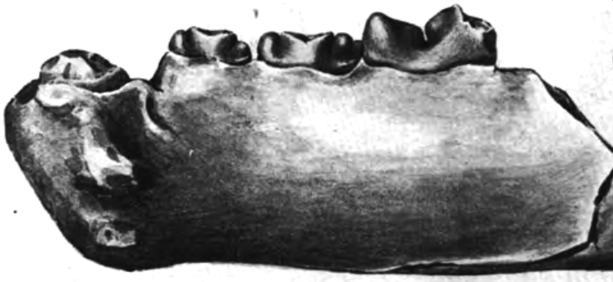
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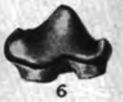
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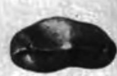
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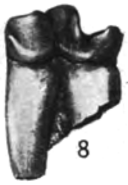
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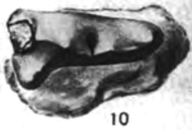
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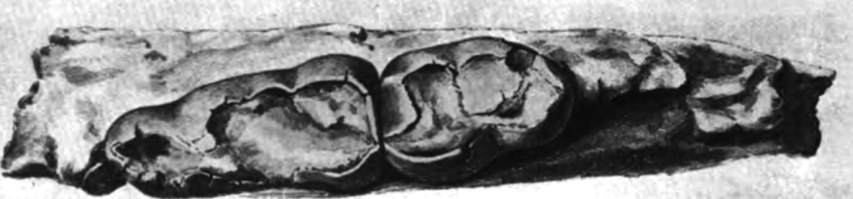
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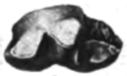
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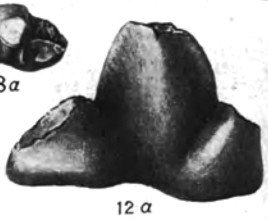
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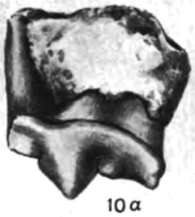
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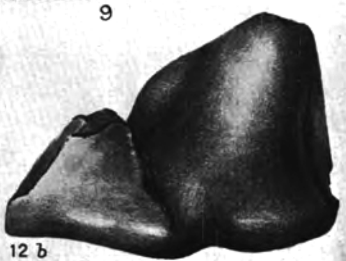
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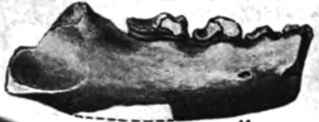
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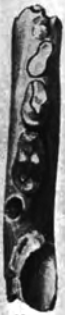
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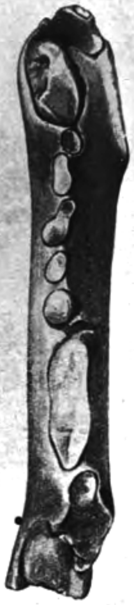
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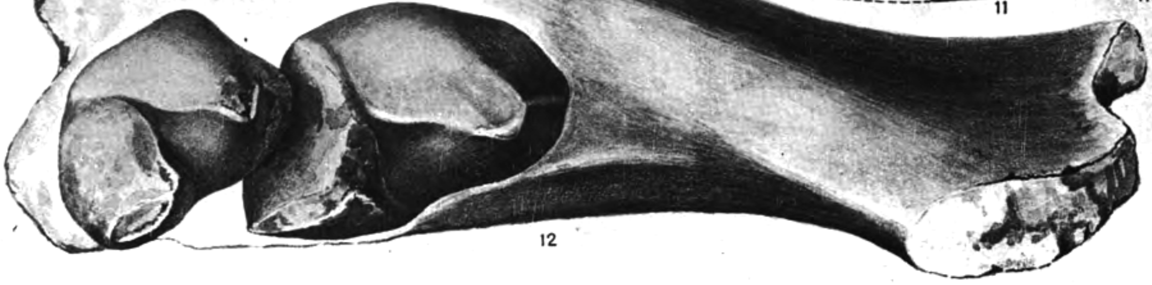
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PLATE IV.

FIGS. 1, 1a. SIVAONYX BATHYGNATHUS (Lyd.). Fragmentary left mandibular ramus with P_4 and the roots or alveoli of P_{1-3} and the canine, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 244); fig. 1, surface view; fig. 1a, view of P_4 from outer side. Page 89.

FIG. 2. VINAYAKIA NOCTURNA, sp. nov. Fragmentary right maxilla with P^2 and P^3 from the lower part of the Dhok Pathan stage near Bahitta 1½ miles S.E. of Padhri (G. S. I. no. D. 218), surface view. Page 159.

FIGS. 3, 3a. FELID, gen. indet., sp. indet. Left M_1 from the Chinji stage of Chinji (G. S. I. no. D. 219); fig. 3, surface view; fig. 3a, view from outer side. Page 164.

FIGS. 4, 4a. VINAYAKIA NOCTURNA, sp. nov. Fragmentary right mandibular ramus with P_{2-3} and the alveoli of P_4 and the canine, from the Nagri stage two miles N. 35° E. of Kadirpur, Attock district (G. S. I. no. D. 221); fig. 4, surface view; fig. 4a, view from inner side. Page 158.

FIGS. 5, 5a, 5b, 5c. VINAYAKIA SARCOPHAGA, sp. nov. Fragmentary maxillæ from the Chinji stage south of Kotalkund, Jhelum district (G. S. I. no. D. 217); fig. 5, surface view of left maxilla with P^3 and part of P^4; fig. 5a, inner view of the same; fig. 5b, outer view of the same; fig. 5c, surface view of right P^2. Page 162.

FIGS. 6, 6a. (?) VISHNUONYX CHINJIENSIS, sp. nov. Fragmentary left mandibular ramus with P_4, the talonid of M_1 and the root of M_2 from the Chinji stage near Chinji (G. S. I. no. D. 245); fig. 6, view from outer side; fig. 6a, surface view. Page 94.

FIGS. 7, 7a, 7b. VISHNUICTIS SALMONTANUS, sp. nov. Fragmentary skull and mandible from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 160); fig. 7, view from above fig. 7a, view from left side; fig. 7b, surface view of P^4 and M^1-2 of the right side. Page 101.

FIGS. 8, 8a. VISHNUICTIS SALMONTANUS, sp. nov. A portion of the left mandibular ramus detached from the specimen in fig. 7, with M_1 and M_2 (G. S. I. no. D. 160); fig. 8, view from outer side; fig. 8a, surface view. Page 103.

FIGS. 9, 9a. VIVERRA (?) CHINJIENSIS, sp. nov. Two portions of the right mandibular ramus with the complete dentition except the hinder part of P_3, from the Chinji stage near Chinji (G. S. I. no. D. 214); fig. 9, view from inner side; fig. 9a, surface view. Page 99.

FIG. 10. VIVERRA (?) CHINJIENSIS, sp. nov. Fragments of the first left upper molar belonging to the same individual as the ramus in fig. 9, surface view. Page 100.

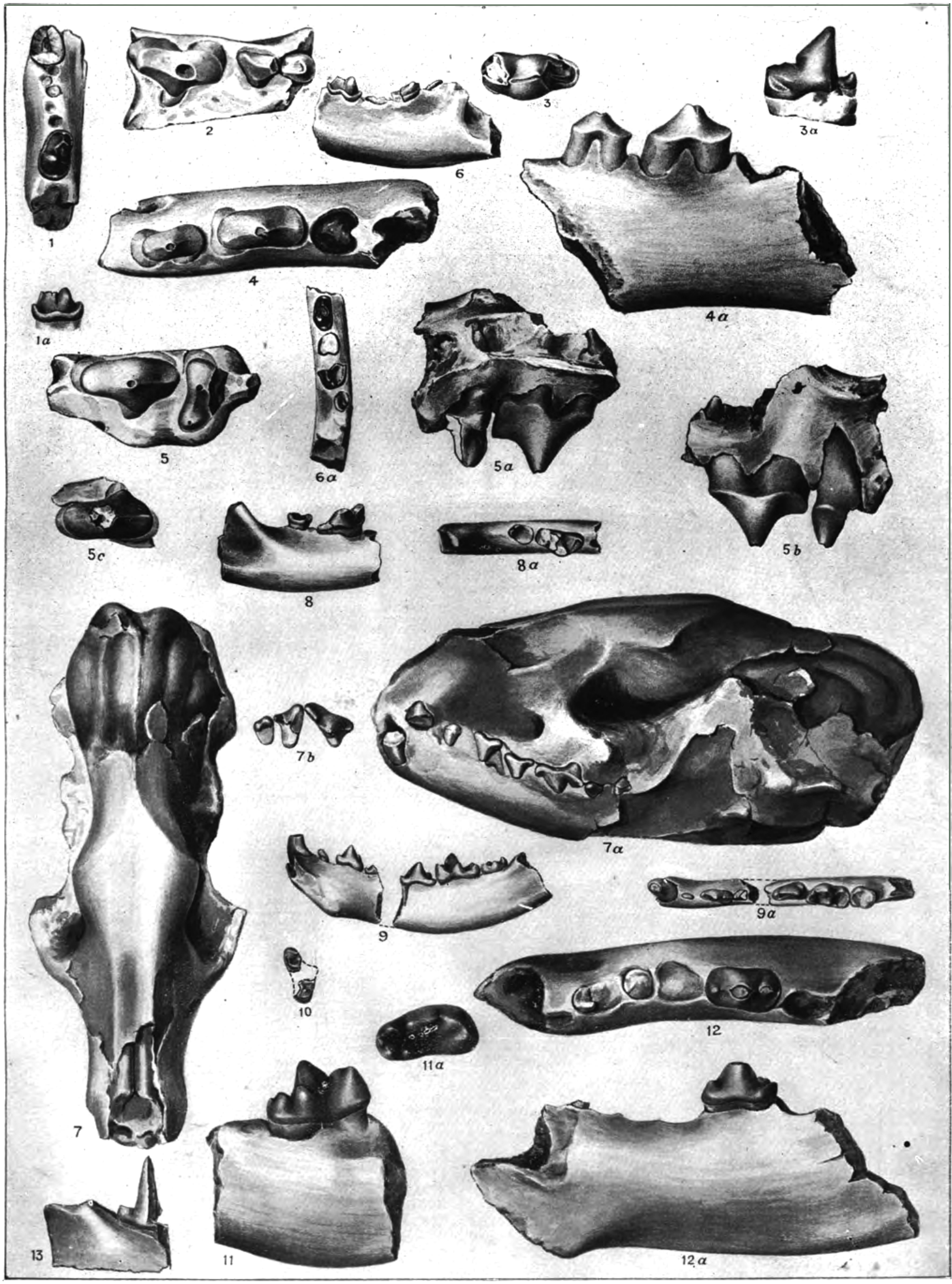
FIGS. 11, 11a. ICTITHERIUM INDICUM, Pilg. Fragmentary left mandibular ramus with M_1 and the alveolus of M_2, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 210); fig. 11, view from inner side; fig. 11a, surface view of M_1. Page 120.

FIGS. 12, 12a. ICTITHERIUM cf. INDICUM, Pilg. Fragmentary right mandibular ramus with P_4 and the roots or alveoli of M_1, P_{1-3} and the canine from the Dhok Pathan stage of Nila (G. S. I. no. D. 211); fig. 12, surface view; fig. 12a, view from inner side. Page 121.

FIG. 13. FELID, gen. indet., sp. indet. Fragment of the right mandibular ramus containing the hinder part of M_1, view from outer side, from the Kamlial stage of Bhagothoro, Sind (G. S. I. no. D. 220). Page 164.

All figures natural size.

Indian Fossil Carnivora.



S. N. Guine, *del.*

G. S. I. Calcutta.

PLATE V.

FIGS. 1, 1a. LYCYÆNA (?) cf. PROAVA (Pilg.). Right maxilla of a juvenile individual with mm^3, mm^2, the alveolus of mm^1, the much damaged mm^4 and the almost perfect M^1 from the Chinji stage near Chinji (G. S. I. no. D. 212); fig. 1, palatal view; fig. 1a, view from outer side. Page 131.

FIGS. 2, 2a. ICTITHERIUM (?) sp. From the Dhok Pathan stage of Hasnot (G. S. I. no. D. 213); fig. 2, view from inner side; fig. 2a, surface view. Page 117.

FIGS. 3, 3a, 3b. ICTITHERIUM cf. SIVALENSE, Lyd. Left maxilla with P^3 and P^4 from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 123); fig. 3, palatal view; fig. 3a, outer view of P^3; fig. 3b, inner view of P^3. Page 116.

FIGS. 4, 4a, 4b. ICTITHERIUM cf. SIVALENSE, Lyd. Left maxilla with P^4 and M^{1-2} from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 124); fig. 4, palatal view; fig. 4a, view of P^4 from outer side; fig. 4b, view of P^4 from inner side. Page 116.

FIGS. 5, 5a, 5b. VIVERRID, gen. indet., sp. indet. Left M_1, from the Chinji stage of Chinji.

FIGS. 6, 6a. LYCYÆNA (?) PROAVA (Pilg.). Left mandibular ramus with P_4, M_1 and the alveolus of M_2 from the Chinji stage of Chinji (G. S. I. no. D. 126); fig. 6, surface view; fig. 6a, view from outer side. Page 131.

FIGS. 7, 7a, 7b. ICTITHERIUM SIVALENSE, Lyd. Left mandibular ramus with M_1 and P_{3-4} and the alveoli of P_{1-2} and the canine from the Dhok Pathan stage of Dhok Pathan (G. S. I. no. D. 125); fig. 7, surface view of tooth crowns; fig. 7a, outer side view; fig. 7b, inner view of tooth crowns; Page 115.

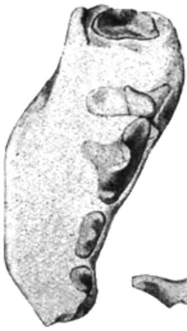
FIGS. 8, 8a, 8b. ICTITHERIUM INDICUM, Pilg. Right upper P^4, from the Dhok Pathan stage of Mithrala (G. S. I. no. D. 246); fig. 8, surface view; fig. 8a, view from inner side; fig. 8b, view from outer side. Page 121.

FIGS. 9, 9a, 9b. LYCYÆNA MACROSTOMA (Lyd.). Left mandibular ramus with M_1, P_3 and the alveoli of P_{1-2}, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 136); fig. 9, surface view; fig. 9a, inner view of tooth crowns; fig. 9b, view from outer side. Page 126.

FIGS. 10, 10a. LYCYÆNA MACROSTOMA (Lyd.). Right mandibular ramus with P_{2-3} and the alveolus of P_1, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. $138)_4$; fig. 10, surface view; fig. 10a, view from inner side. Page 126.

All figures natural size.

Indian Fossil Carnivora.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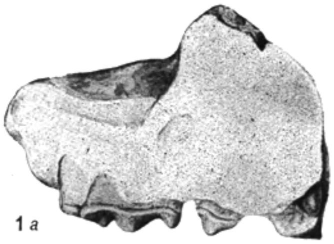
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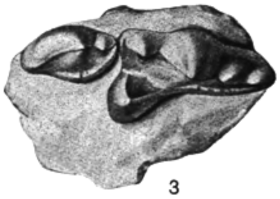
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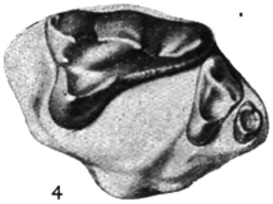
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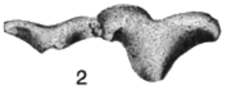
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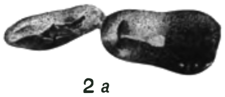
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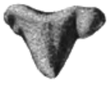
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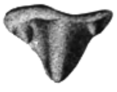
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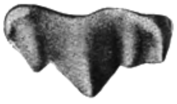
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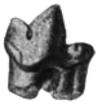
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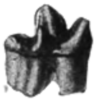
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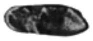
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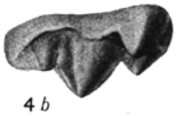
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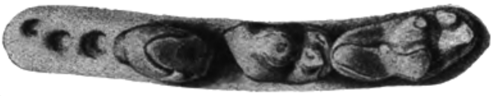
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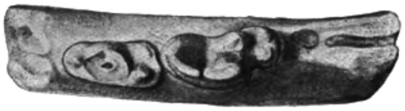
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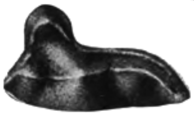
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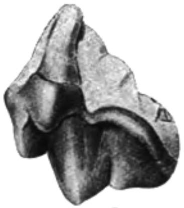
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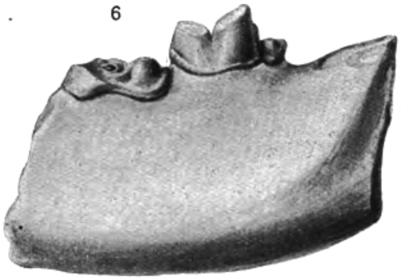
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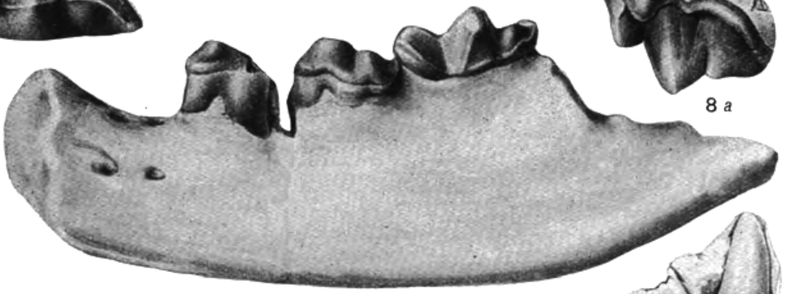
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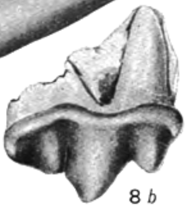
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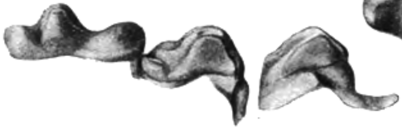
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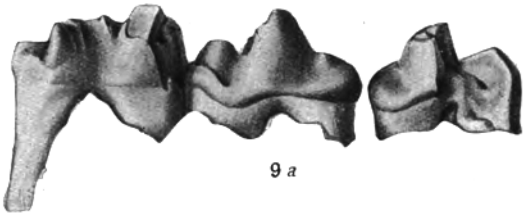
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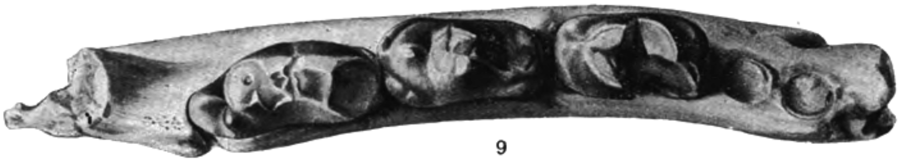
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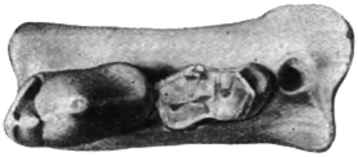
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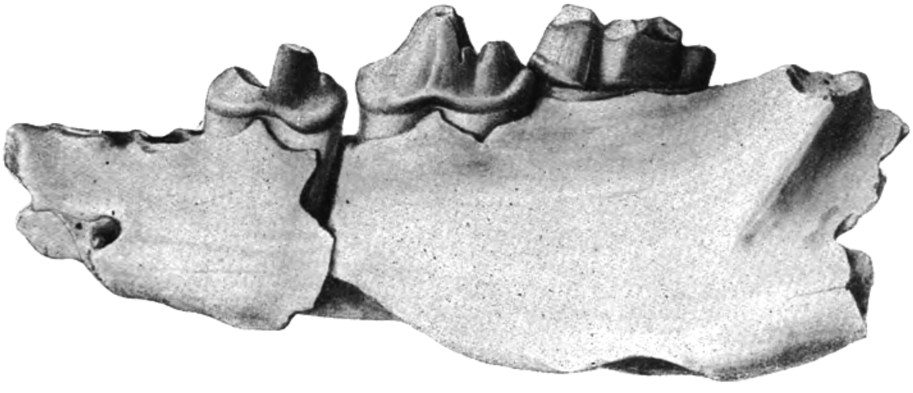
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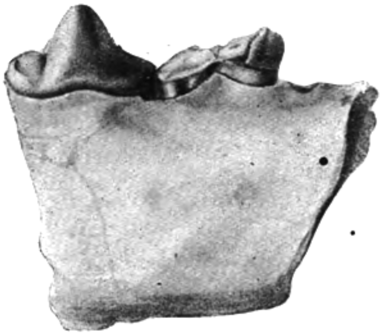
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S. N. GUINE, *del.* figs. 1-4, 8 & G. M. WOODWARD, *del.* figs, 5-7, 9, 10. *G. S. I. Calcutta.*

PLATE VI.

FIGS. 1, 1a, 1b, 1c. CROCUTA MORDAX, sp. nov. Left maxilla of a juvenile individual, in which the milk dentition has been removed in order to expose the permanent P^3, P^4 and M^1, from the Dhok Pathan stage of Dhok Pathan (G. S. I. no. D. 205); fig. 1, crown view of M^1, P^4 and P^3 in their actual position in the maxilla; fig. 1a, inner view of M^1; fig. 1b, outer view of P^3 and P^4; fig. 1c, inner view of P^3 and P^4. Page 150.

FIGS. 2, 2a. CROCUTA GIGANTEA (Schlosser) var. LATRO, var. nov. Right maxilla with P^4 and the root of P^3, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 206); fig. 2, palatal view; fig. 2a, view from outer side. Page 147.

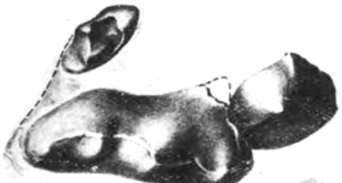
FIGS. 3, 3a, 3b, 3c. CROCUTA MORDAX, sp. nov. Left ramus of a mandible associated with the maxilla of fig. 1 and probably belonging to the same individual (G. S. I. no. D. 204) fig. 3, view from inner side showing M_1 and P_{2-4}, which have been exposed by chipping away the side of the jaw; fig. 3a, surface view of P_{2-4}; fig. 3b, surface view of M_1; fig. 3c, view of M_1 from outer side. Page 151.

FIG. 4. CROCUTA MORDAX, sp. nov. Right ramus of the same mandible of which the left ramus is figured in fig. 3 (G. S. I. no. D. 204); surface view showing the much broken milk dentition. Page 152.

FIGS. 5, 5a, 5b. ICTITHERIUM cf. SIVALENSE, Lyd. Fragmentary left mandibular ramus with M_1, P_4 and the hinder half of P_3 from the Middle Siwaliks of Haritalyangar, Bilaspur State, Simla Hills (G. S. I. no. D. 122); fig. 5, view from inner side; fig. 5a, view from outer side; fig. 5b, surface view. Page 114.

FIGS. 6, 6a, 6b. LYCYÆNA (?) CHINJIENSIS, sp. nov. Fragmentary right mandibular ramus of an immature individual with M_1 just erupting, from the Chinji stage of Chinji (G. S. I. no. D. 233); fig. 6, surface view; fig. 6a, view from inner side; fig. 6b, view from outer side. Page 134.

All figures natural size.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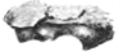
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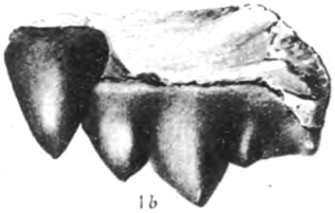
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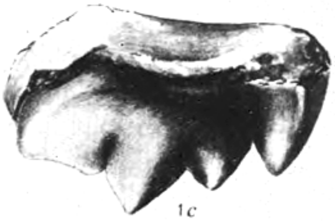
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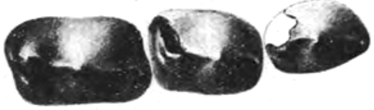
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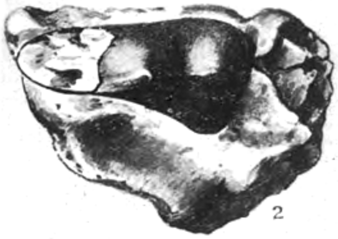
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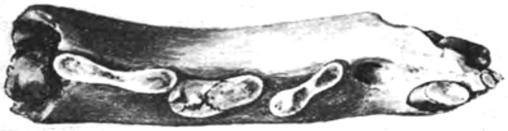
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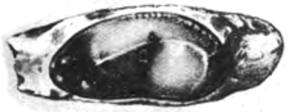
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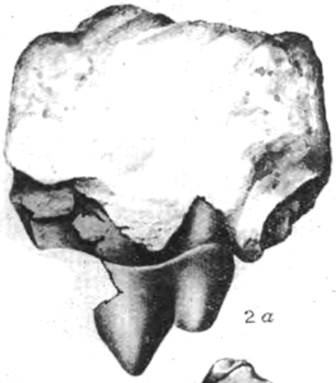
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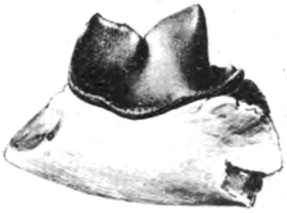
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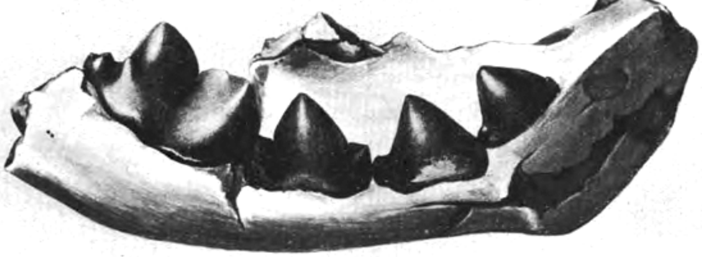
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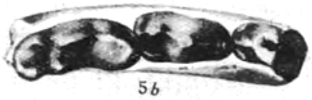
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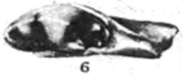
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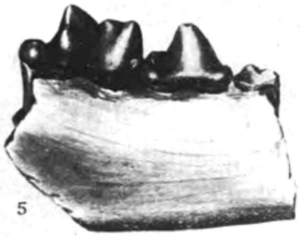
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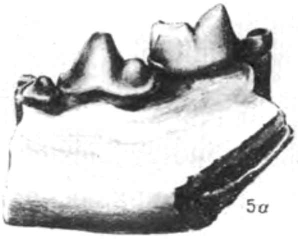
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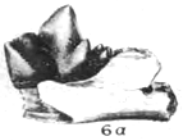
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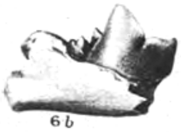
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S. N. Guine, *del.* *G. S. I. Calcutta.*

PLATE VII.

FIGS. 1, 1a. CROCUTA CARNIFEX (Pilg.). Right mandibular ramus of a juvenile individual, from the Chinji stage of Chinji (G. S. I. no. D. 172); fig. 1, view of ramus from outer side, showing M_1, P_{2-4} and the canine, which have been exposed by chipping away the jaw beneath the milk dentition; fig. 1a, surface view of M_1 in the same ramus. Page 144.

FIGS. 2, 2a. CROCUTA cf. CARNIFEX (Pilg.). Left upper P^4 from the Chinji stage of Chinji (G. S. I. no. D. 168); fig. 2, view from outer side; fig. 2a, surface view. Page 142.

FIGS. 3, 3a. CROCUTA CARNIFEX (Pilg.). Fragmentary left mandibular ramus with P_2 and P_3 and part of the alveolus of the canine from the Chinji stage of Chinji (G. S. I. no. D. 170); fig. 3, surface view; fig. 3a, view from outer side. Page 144.

FIGS. 4, 4a. CROCUTA CARNIFEX (Pilg.). Fragmentary left mandibular ramus with P_3 and P_4, from the Chinji stage of Chinji (G. S. I. no. D. 171); fig. 4, surface view; fig. 4a, view from outer side. Page 142.

FIGS. 5, 5a. CROCUTA cf. CARNIFEX (Pilg.). Right lower M_1 from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 164); fig. 5, surface view; fig. 5a, view from outer side. Page 142.

FIGS. 6, 6a. LYCYÆNA MACROSTOMA (Lyd.) var. VINAYAKI, var. nov. Right upper P^3, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 137); fig. 6, view from inner side; fig. 6a, surface view. Page 130.

FIGS. 7, 7a. LYCYÆNA MACROSTOMA (Lyd.) var. VINAYAKI, var. nov. Left upper P^2 of probably the same individual as fig. 6 (G. S. I. no. D. 137); fig. 7, view from inner side; fig. 7a, surface view. Page 130.

FIGS. 8, 8a. LYCYÆNA MACROSTOMA (Lyd.) var. VINAYAKI, var. nov. Right lower P_4 of probably the same individual as the two preceding figures (G. S. I. no. D. 139); fig. 8, view from inner side; fig. 8a, surface view. Page 130.

FIGS. 9, 9a. LYCYÆNA MACROSTOMA (Lyd.) var. VINAYAKI, var. nov. Fragment of the left mandibular ramus with P_3, of probably the same individual as the three preceding figures (G. S. I. no. D. 139); fig. 9, view from inner side; fig. 9a, surface view. Page 130.

FIGS. 10, 10a. CROCUTA MORDAX, sp. nov. Fragment of the right mandibular ramus with P_3 from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 163); fig. 10, surface view; fig. 10a, view from inner side. Pages 150, 151, 152.

FIGS. 11, 11a. CROCUTA GIGANTEA (Schlosser) var. LATRO, var. nov. Left mandibular ramus with P_4 and the broken crown of M_1, from the Dhok Pathan stage of Nila (G. S. I. no. D. 162); fig. 11, view from inner side; fig. 11a, surface view of P_4. Page 148.

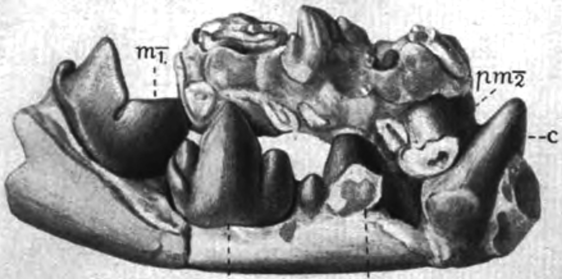
FIGS. 12, 12a. CROCUTA CARNIFEX (Pilg.). Fragmentary left mandibular ramus with P_2, P_3 and the broken base of the canine, from the Chinji stage of Chinji (G. S. I. no. D. 169); fig. 12, surface view; fig. 12a, view from outer side. Pages 142, 144.

FIGS. 13, 13a. CROCUTA GIGANTEA (Schlosser) var. LATRO, var. nov. Right upper P^3 from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 208); fig. 13, surface view; fig. 13a, view from inner side. Pages 146, 147.

All figures natural size.

Indian Fossil Carnivora.

Geol. Surv. of India. Pl. VII.



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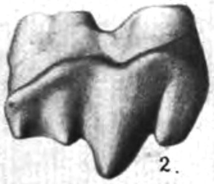
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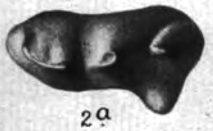
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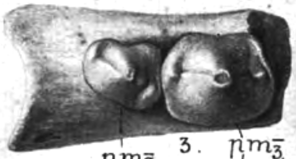
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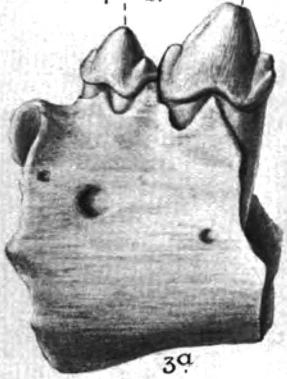
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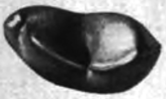
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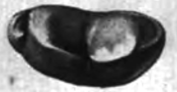
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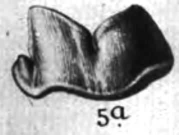
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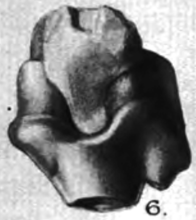
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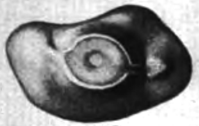
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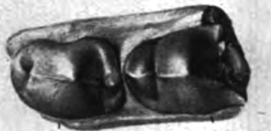
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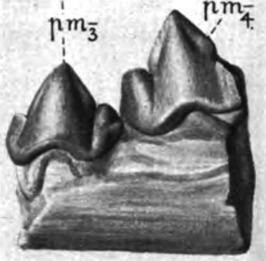
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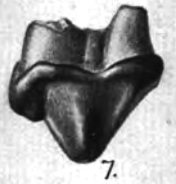
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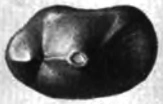
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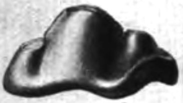
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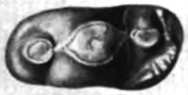
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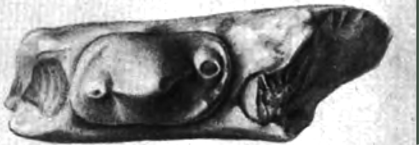
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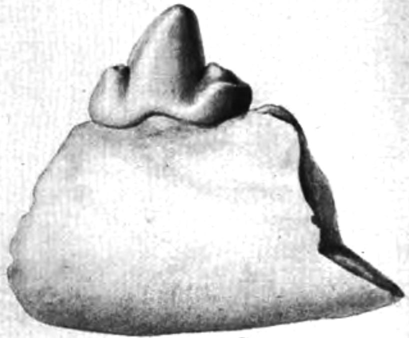
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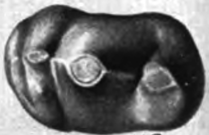
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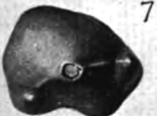
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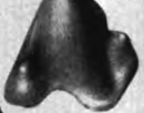
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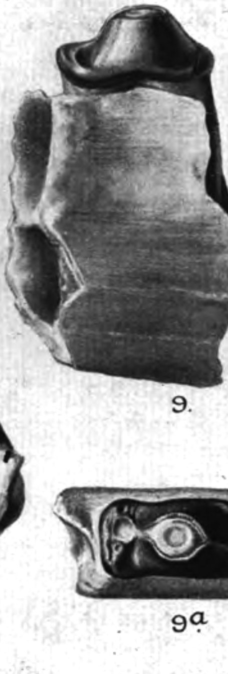
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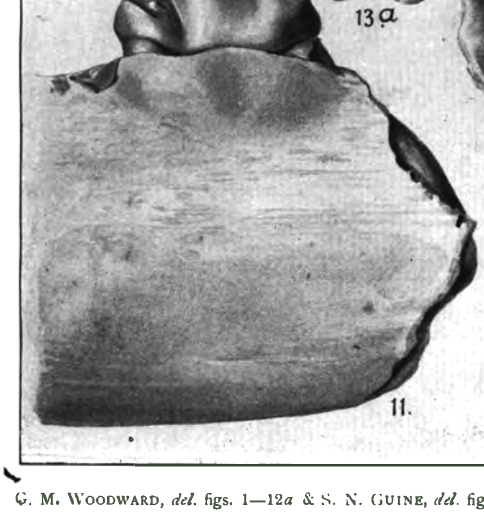
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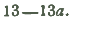
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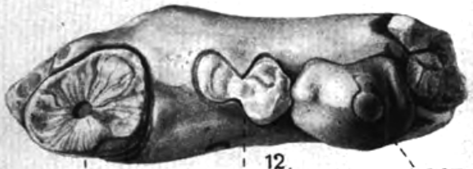
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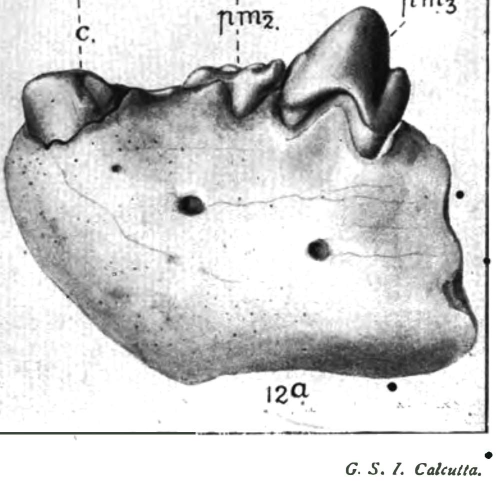
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G. M. Woodward, *del.* figs. 1—12*a* & S. N. Guine, *del.* figs. 13—13*a*. *G. S. I. Calcutta.*

PLATE VIII.

FIGS. 1, 1a. CROCUTA GIGANTEA (Schlosser) var. LATRO, var. nov. Hinder portion of right mandibular ramus with P_4 and the alveoli of M_1, from the Nagri stage about two miles N. 35° E. of Kadirpur (G. S. I. no. D. 209); fig. 1, view from outer side; fig. 1a, surface view of P_4. Page 147.

FIGS. 2, 2a, 2b, 2c. CROCUTA CARNIFEX (Pilg.). Right maxilla probably belonging to the same juvenile individual as the mandibular ramus figured in Plate VII, fig. 1, with P^2, P^3 and the canine, which have been exposed by destroying the milk dentition, from the Chinji stage of Chinji (G. S. I. no. D. 173); fig. 2, view from outer side; fig. 2a, palatal view; fig. 2b, mm^2 surface view; fig. 2c, mm^2 from the side. Page 143.

FIGS. 3, 3a, 3b. CROCUTA GIGANTEA (Schlosser) var. LATRO, var. nov. Fragmentary right mandibular ramus of a juvenile individual with mm_2 and mm_3 in place, and showing the germ of P_2, which has been exposed by cutting away the jaw, from the Nagri stage of Haritalyangar, Belaspur State, Simla Hills (G. S. I. no. D. 231); fig. 3, view from outer side; fig. 3a, surface view; fig. 3b, surface view of P_2 after removal from the jaw. Page 148.

FIGS. 4, 4a. INCERTÆ SEDIS. (? lower premolars of a Suid).

FIGS. 5, 5a, 5b. SANSANOSMILUS (?) cf. RHOMBOIDALIS, sp. nov. Left P^4, somewhat damaged at the antero-internal corner, from the Chinji stage of Chinji (G. S. I. no. D. 153); fig. 5, view from inner side; fig. 5a, view from outer side; fig. 5b, surface view. Page 184.

FIGS. 6, 6a. PARAMACHÆRODUS cf. PILGRIMI, Kretzoi. Right mandibular ramus with M_1 and P_4, from the Dhok Pathan stage of Kotal Kund (G. S. I. no. D. 167); fig. 6, surface view; fig. 6a, view from outer side. Page 188.

FIGS. 7, 7a. PARAMACHÆRODUS cf. INDICUS (Kretzoi). Right upper canine from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 261); fig. 7, side view; fig. 7a, surface view. Page 190.

FIGS. 8, 8a. (?) PROPONTOSMILUS SIVALENSIS (Lydekker). Right lower canine, from the Dhok Pathan stage of Hasnot (G. S. I. no. D. 262); fig. 8, side view; fig. 8a, surface view. Page 192.

FIGS. 9, 9a, 9b, 9c. SANSANOSMILUS (?) SERRATUS, sp. nov. Left mandibular ramus with the damaged M_1 and P_4, from the Chinji stage of Chinji (G. S. I. no. D. 165); fig. 9, view from inner side; fig. 9a, surface view; fig. 9b, the posterior edge of M_1, three times enlarged; fig. 9c, the posterior edge of the main cusp of P_4, three times enlarged. Page 181.

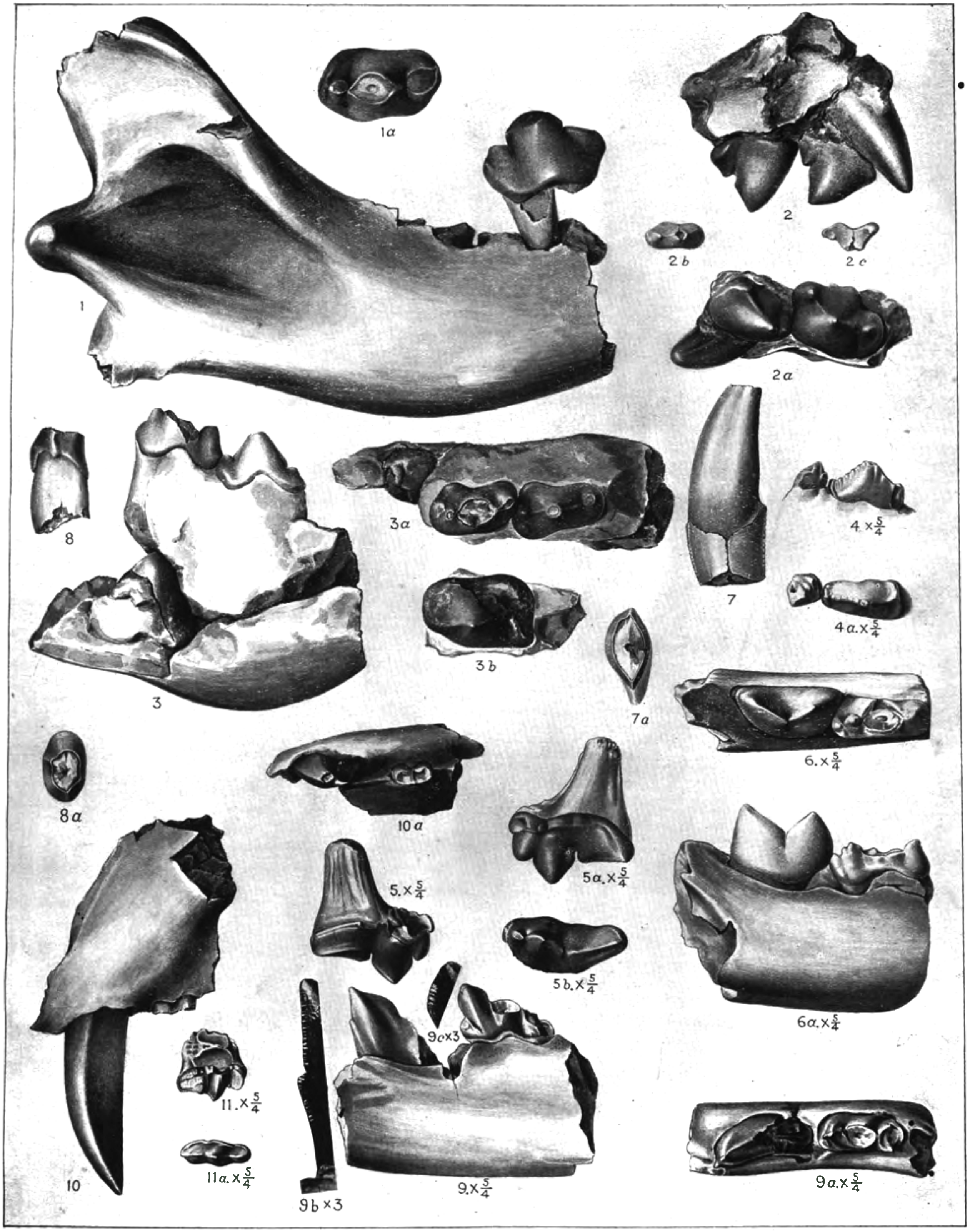
FIGS. 10, 10a. SANSANOSMILUS (?) RHOMBOIDALIS, sp. nov. Left maxilla, with the canine and the roots of P^3, from the Chinji stage of Chinji (G. S. I. no. D. 154); fig. 10, view from outer side; fig. 10a, surface view. Page 184.

FIGS. 11, 11a. SANSANOSMILUS (?) cf. RHOMBOIDALIS, sp. nov. Left mm^3 from the Chinji stage of Chinji (G. S. I. no. D. 152); fig. 11, view from inner side; fig. 11a, surface view. Page 184.

Figures 4-6, 9, 9a and 11 are $\frac{5}{4}$ natural size; figs. 9b, 9c are 3 times natural size; the remaining figures are natural size.

Indian Fossil Carnivora.

Geol. Surv. of India. Pl. VIII.



S. N. GUINE, *del.* *G. S. I. Calcutta.*

PLATE IX.

FIGS. 1, 1a, 1b. VISHNUFELIS LATICEPS, sp. nov. Reconstructed skull from the Chinji stage 2¾ miles E. of Paridarwaza, Jhelum district (G. S. I. no. D. 266) ; fig. 1, palatal view ; fig. 1a, view from above ; fig. 1b, view from right desi ; i^3 third upper incisor , *l.c.*, broken tip of lower canine ; *u.c.*, upper canine ; *io.f.*, infra-orbital foramen. *mas. p.*, mastoid process ; *par. p.*, paroccipital process ; *gl. f.*, glenoid foramen ; *gl.c.*, glenoid crest ; *pgl.f.*, post glenoid foramen ; *mat.*, matrix. Page 206.

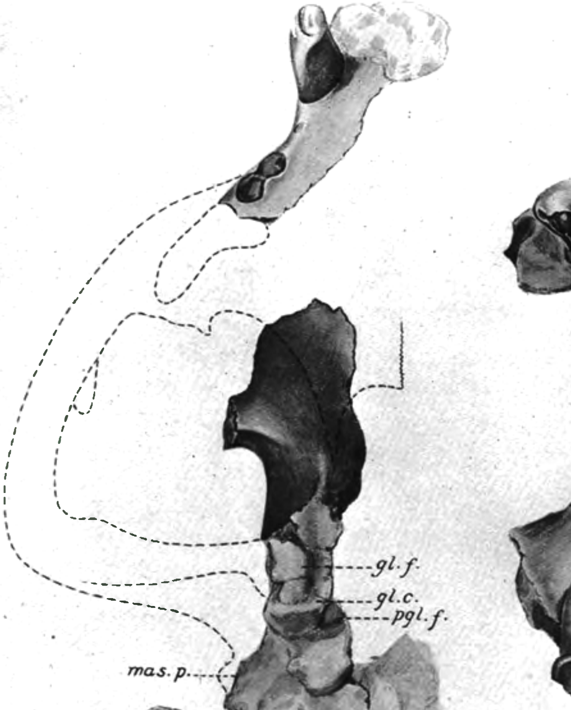
FIGS. 2, 2a. MEGANTEREON (?) PRAECOX, sp. nov. Left maxilla with P^4 and the broken root of M^1, from the Nagri stage of Haritalyangar, Simla Hills (G. S. I. no. D. 232) ; fig. 2, surface view ; fig. 2a, view from outer side. Page 179.

FIGS. 3, 3a. LYCYÆNA cf. MACROSTOMA (Lyd.) var. VINAYAKI, var. nov. Fragment of right maxilla with P^3 and the anterior roots of P^4, from the Dhok Pathan stage of Chhokar, Jhelum district, Salt Range area (G. S. I. no. D. 260) ; fig. 3, view from outer side ; fig. 3a, surface view. Page 130.

FIGS. 4, 4a. ICTITHERIUM SIVALENSE, Lydekker. Mandible, lacking posterior portion and with tooth crowns damaged, from the Dhok Pathan stage of Ahmdal, Attock district (G. S. I. no. D. 253) ; fig. 4, view from right side ; fig. 4a, surface view. Pages 114, 115.

FIGS. 5, 5a. HYÆNID (? ICTITHERIUM) sp. indet. Right mandibular ramus, with the damaged M_1 and the alveolus of M_2, from the Chinji stage of Chinji (G. S. I. no. D. 241) ; fig. 5, view from outer side ; fig. 5a, surface view.

All figures natural size.



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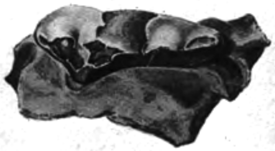

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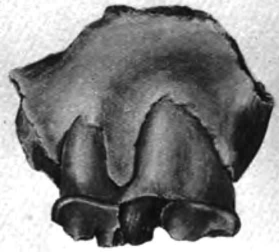

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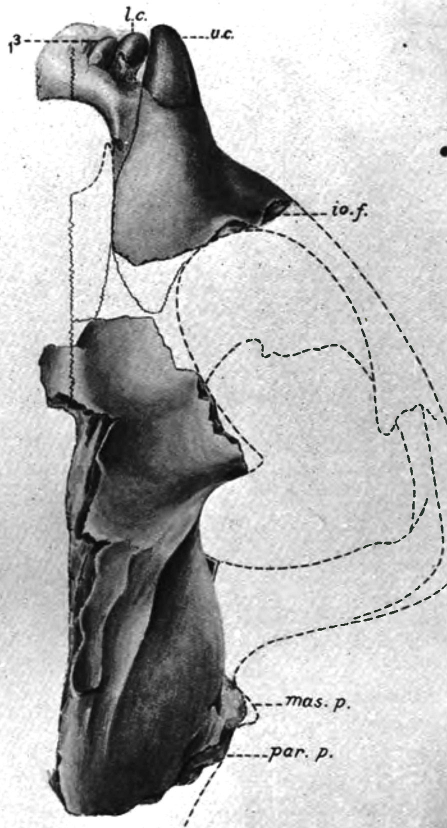

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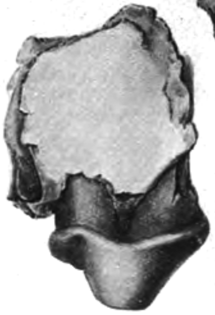

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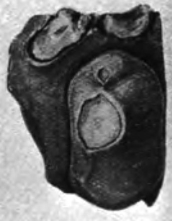

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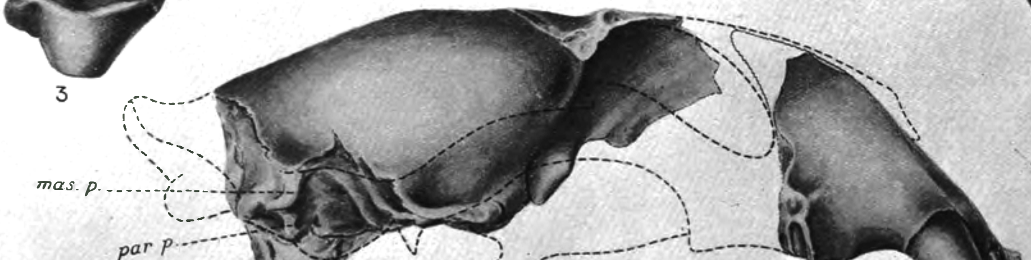

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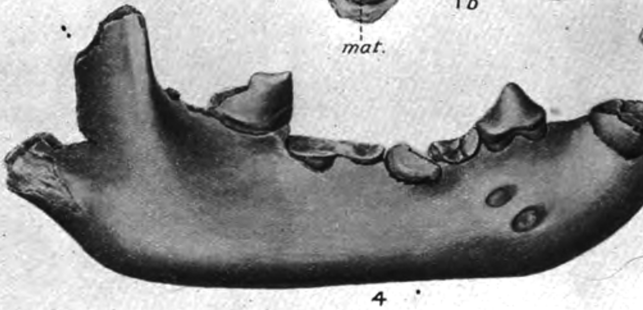

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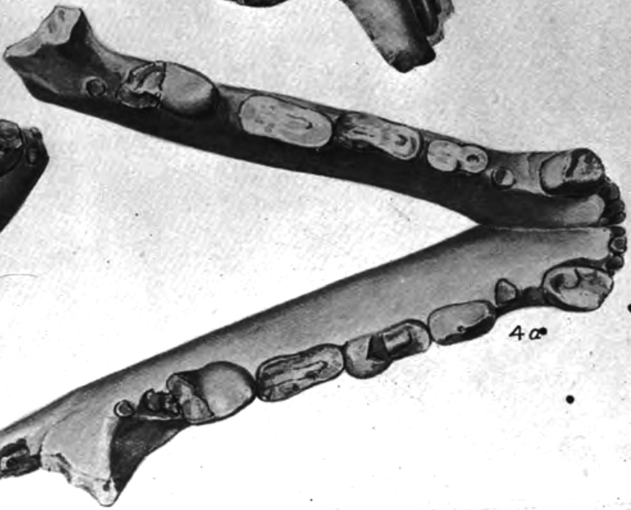

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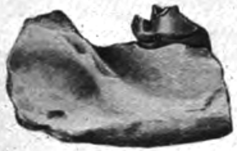

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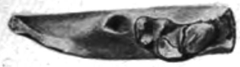


5a

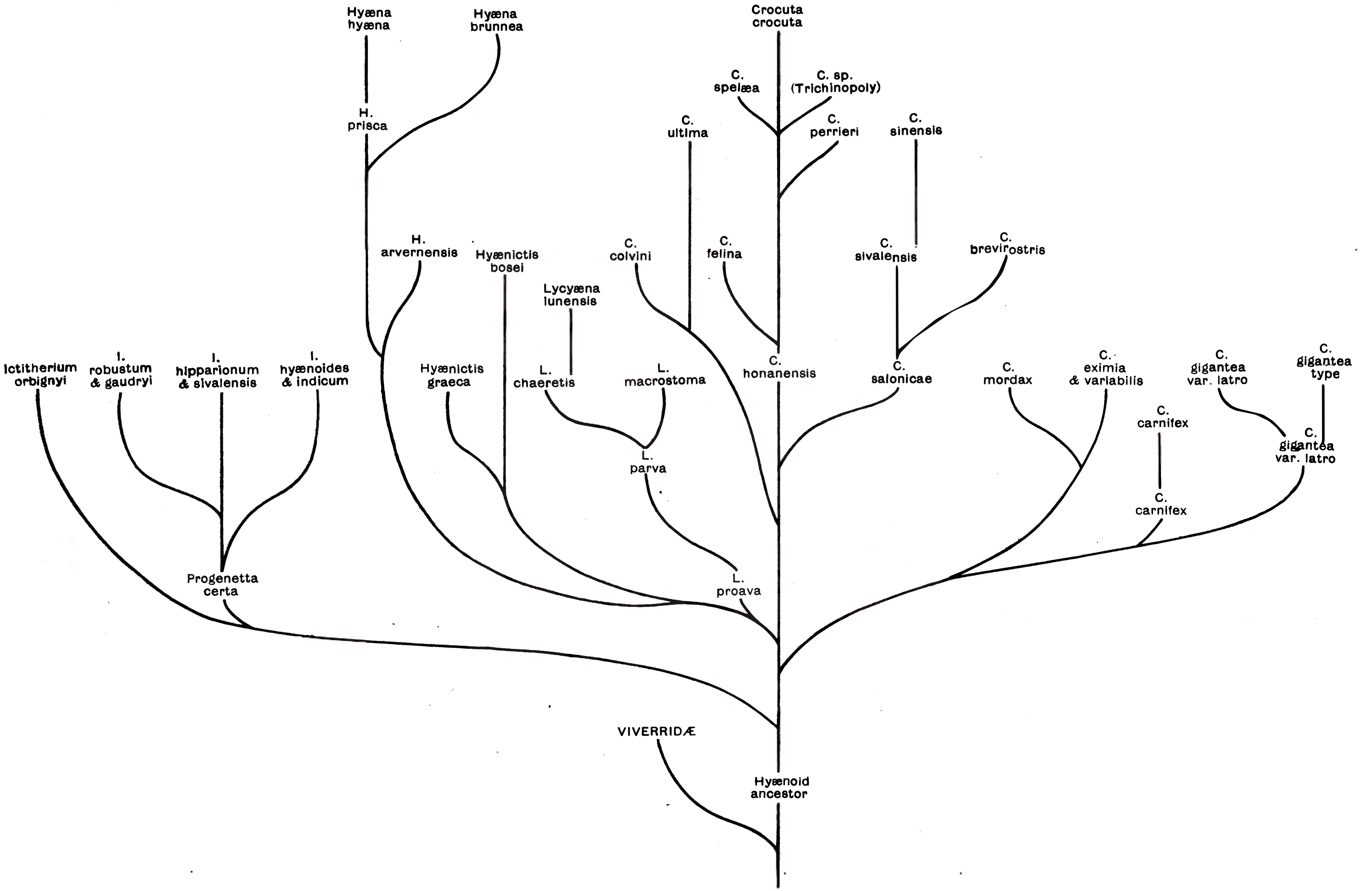
S. [illegible] Guine, del.

G. S. I. Calcutta.

PLATE X.

Suggested phylogeny of the Hyænidæ.

MGIPC—M—VIII-4-9—12-3-32—435.



SUGGESTED PHYLOGENY OF THE HYÆNIDÆ.

Litho. G. S. I. Calcutta.